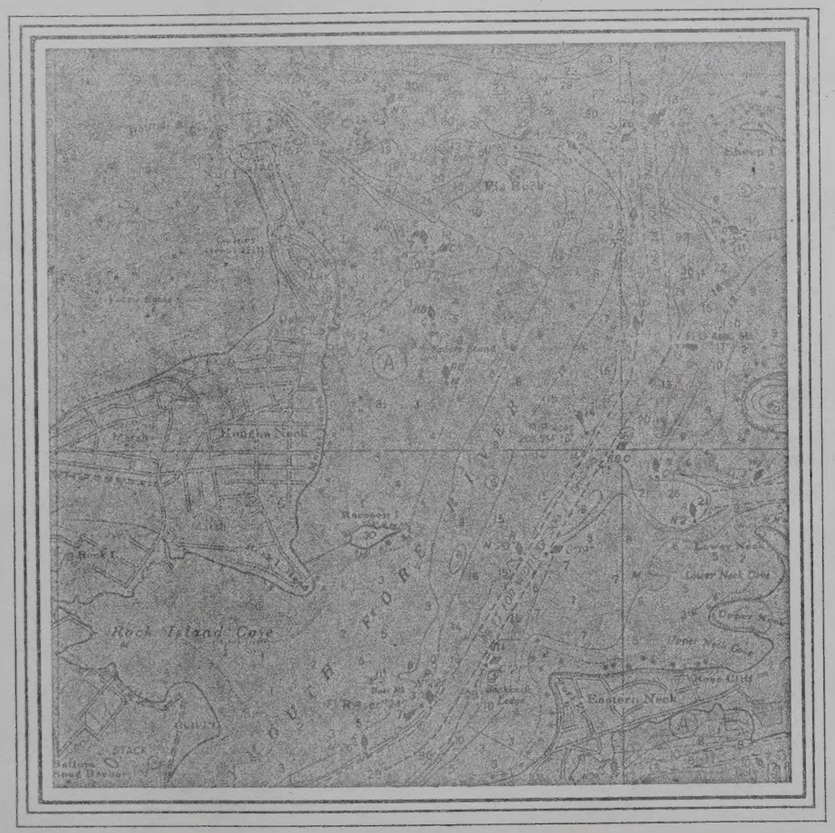
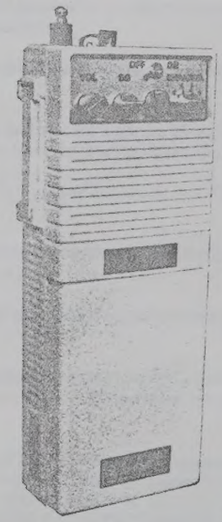
apelco

Apelco Marine Electronics
676 Island Pond Road, Manchester, N.H. 03103
(603) 668-1600

Doc. No. 983433 (First Printing July 1978)


Rock Island Cove
Eastern Neck
Lower Neck
Lower Neck Cove
Upper Neck
Upper Neck Cove
Rowes Cliff
Rowes Neck
Pig Rock
Ram Island
Ram Island Ledge
Mackerel Ledge
Ram Island Cove
Ram Island Harbor
Ram Island Bar
Ram Island Bar Ledge
Ram Island Bar Ledge
Ram Island Bar Ledge

Model AF6
VHF-FM Radiotelephone
Instruction Manual



apelco MARINE ELECTRONICS
676 ISLAND POND ROAD
MANCHESTER, NEW HAMPSHIRE 03103
Doc. No. 983433 (First Printing July 1978)

apelco Limited Warranty

Distributor Products

Apelco Marine Electronics warrants all parts of each new product against defects in material and workmanship under normal use, and will repair or exchange any parts proven to be defective at no charge for a period of TWO YEARS from the date of original installation, EXCEPT AS PROVIDED BELOW.

Defects will be corrected by an authorized Apelco Marine Electronics Service Station. There will be no charge for labor for a period of ONE YEAR from date of original installation, EXCEPT AS PROVIDED BELOW.

WARRANTY LIMITATIONS

Apelco Marine Electronics will not be responsible for equipment which has been subjected to accident, abuse, or misuse, nor any equipment on which the serial plate has been removed, altered, or mutilated.

Except where Apelco Marine Electronics has performed the installation, it assumes no responsibility for damage incurred during installation.

This warranty is effective only with respect to the original purchaser from an authorized Apelco Marine Electronics Representative.

A validated warranty certificate and station logbook (if applicable) must be made available to the authorized Apelco Marine Electronics Service Station at the time of service.

Chart paper, stylii, stylus belts, lamps, and fuses are consumable items, and are not covered by this warranty.

Any cost associated with transducer replacement, other than the cost of the transducer itself, is specifically excluded from this warranty.

Equipment must be forwarded to an authorized Service Station at owner's expense, and will be returned at no cost to the owner.

Apelco Marine Electronics equipment or parts thereof which have been repaired or altered outside of its plant except by authorized Apelco Marine Electronics Service Stations are not warranted in any respect.

This warranty is STRICTLY LIMITED to the terms indicated herein, and no other express warranties or remedies thereunder shall be binding on Apelco Marine Electronics. TO THE EXTENT CONSISTENT WITH STATE AND FEDERAL LAW. (1) ANY IMPLIED WARRANTIES SHALL BE LIMITED TO THE SAME TIME PERIODS STATED HEREIN FOR EXPRESS WARRANTIES, AND (2) APELCO MARINE ELECTRONICS SHALL NOT BE LIABLE FOR CONSEQUENTIAL DAMAGES UNDER ANY EXPRESS OR IMPLIED WARRANTIES RELATING TO THIS EQUIPMENT.

APELCO MARINE ELECTRONICS
676 Island Pond Road, Manchester, New Hampshire 03103

NOTE: THE SAMPLE WARRANTY STATEMENT IS FURNISHED FOR REFERENCE ONLY. PLEASE REFER TO THE WARRANTY CERTIFICATE ISSUED WITH YOUR EQUIPMENT FOR SPECIFIC TERMS AND CONDITIONS.

PURPOSE

THIS MANUAL CONTAINS IMPORTANT INFORMATION ON THE INSTALLATION, OPERATION AND MAINTENANCE OF YOUR EQUIPMENT.

APELCO MARINE ELECTRONICS products are supported by a worldwide network of Authorized Service Representatives.

The below-listed Apelco Marine Electronics Factory Service Centers will either assist you directly, or refer you to an Authorized Service Representative.

FACTORY SERVICE CENTERS

CALIFORNIA:
633 N. Marine Avenue
Wilmington, Ca. 90744
(Los Angeles)
Phone: (213) 835-0147

FLORIDA:
1107 N. Ward Street
Tampa, Fl. 33607
Phone: (813) 877-9418

LOUISIANA:
525 Jefferson Street
New Orleans, La. 70121
Phone: (504) 835-6491

NEW HAMPSHIRE:
25 Industrial Village
Londonderry, N.H. 03053
(Manchester)
Phone: (603) 668-1600

NEW YORK:
756 5th Avenue
Brooklyn, N.Y. 11232
Phone: (212) 768-2511

TEXAS:
1203 Galveston Street
South Houston, Tx. 77587
Phone: (713) 941-2700

VIRGINIA:
6529 Tidewater Drive
Norfolk, Va. 23509
Phone: (804) 857-0178

WASHINGTON:
4800 20th Ave. NW
Seattle, Wa. 98107
Phone: (206) 782-0242

TABLE OF CONTENTS

		Page
SECTION 1	INTRODUCTION	
1.1	General Description.....	1-1
1.2	Specifications.....	1-1
SECTION 2	OPERATION	
2.1	Controls & Switches.....	2-1
2.2	Operating Instructions.....	2-2
2.3	Battery Requirement.....	2-2
SECTION 3	RADIOTELEPHONE SERVICES	
3.1	Basic Radiotelephone Service.....	3-1
3.2	Getting on the Air.....	3-1
3.3	Technical Requirements.....	3-1
3.4	Register with the Coast Station.....	3-2
3.5	Marine Radiotelephone.....	3-2
3.6	Distress, Urgency and Safety Messages.....	3-5
3.7	Weather Broadcasts.....	3-6
3.8	Keeping the Log.....	3-6
3.9	Phonetic Alphabet.....	3-7
SECTION 4	THEORY OF OPERATION	
4.1	Receiver.....	4-1
4.2	Transmitter.....	4-2
SECTION 5	MAINTENANCE	
5.1	General.....	5-1
5.2	Tools and Equipment.....	5-1
5.3	Receiver.....	5-2
5.4	Transmitter Alignment.....	5-4
SECTION 6	PARTS LIST & SCHEMATIC.....	6-1

LIST OF ILLUSTRATIONS

Fig. No.	Title	Page
2-1	Operator Controls and Indicators....	2-3
4-1	Block Diagram, Model AF6.....	4-4
5-1	Equipment Set-up, Receiver Alignment	5-3
5-2	Equipment Set-up, Transmitter.....	5-4
5-3	Alignment Components Adjusted for Receiver...	5-6
5-4	Alignment (Main PC Board) Components Adjusted for Receiver...	5-7
5-5	Alignment (Crystal Oscillator PC Board) Components Adjusted for Transmitter	5-8
5-6	Alignment (Main PC Board) Components Adjusted for Transmitter	5-9
6-1	Alignment (Crystal Oscillator PC Board) AF6 Schematic Diagram.....	6-13

LIST OF TABLES

Table	Title	Page
5.5 (para no.)	Transistor Voltage Table.....	5-10
6-1	AF6 Parts List.....	6-2

SECTION 1

INTRODUCTION

1.1 GENERAL DESCRIPTION

The AF6 VHF/FM marine transceiver is an entirely self-contained radio which provides the safety and convenience of VHF marine communications in one compact unit. It is ideal for small craft which do not have power sources, for harbor communications, and for low power/short distance ship to shore use.

It is designed to perform reliably in harsh marine conditions. Crystals are supplied for channels 06 and 16. The AF6 will operate from AA cells, 12 VDC external power source, or an optional rechargeable power pack.

1.2 SPECIFICATIONS

General

Dimensions	216mm (H) x 87mm (W) x 47mm (D) (8.5" x 3.42" x 1.85")
Weight	Approx. 1kg(2.2lbs) w/rechargeable power pack
Power requirement	12 VDC
Current Drain	Transmit: approx. 380mA @ 12 VDC
	Receive: Max. audio output 100mA @ 12 VDC
	Stand-by: Squelch on, 20mA @ 12 VDC
Power Source	8AA penlight cells, or optional rechargeable power pack
Channels	6, crystals for 06 and 16 supplied
Output impedance	50 ohms nominal
Frequency range	156 to 162 MHz

Transmitter

Circuit system	Crystal-controlled, phase modulation
Crystals	HC-25 holder Dwg. No. 983533
Nominal RF output	1 watt (13.6 VDC input)
Frequency multiplication	12 times
Frequency stability	±10 x 10^{-6} from -20°C to +50°C ambient temperature (10 to 14 VDC)
Max. frequency deviation	±5 kHz (frequency modulation)
TX audio frequency response	Within +1 dB and -3 dB of true 6 dB per octave, pre-emphasis from 300 Hz to 3000 Hz
Minimum signal/noise ratio	At least 35 dB below 3.3 kHz deviation at 1 kHz
Spurious and harmonic suppression	Exceeds FCC and DOC requirements
Audio filter	Exceeds FCC and DOC requirements

Receiver

Circuit system	Crystal-controlled, double conversion superheterodyne
Crystals	HC-25 holder Dwg. No. 983534
Frequency stability	±10 x 10^{-6} from -20°C to 50°C ambient temperature (10 to 14 VDC)
Sensitivity:	
20 dB noise quieting	Better than 0.5 uV
12 dB SINAD	Better than 0.4 uV
Modulation acceptance	More than 7 kHz (EIA)
Selectivity	More than 70 dB @ 20 kHz (20 dB quieting method): Exceeds FCC and DOC requirements

Spurious and image response	60 dB below rated sensitivity: Exceeds FCC and DOC requirements
Squelch sensitivity	Noise compensated type: 0.3 uV threshold; below 2 uV with full squelch
Adjacent channel selectivity	Two signal generator method: better than 65 dB @ 25 kHz
Intermodulation	55 dB (EIA SINAD, three generator method) Exceeds FCC & DOC requirements
Audio frequency response	Within +2 dB and -8 dB of true 6 dB per octave, de-emphasis from 300 to 3000 Hz
Audio output power	More than 1/2 watt with less than 10% distortion

SECTION 2

OPERATION

2.1 CONTROLS & SWITCHES

CHANNEL Selector - Place the dial on the channel you wish to use. Channel 16 is the emergency channel. It is also used for calling. Channel 6 is for intership safety/search and rescue.

ON/OFF Switch - Turns the power on and off.

Volume (VOL) Control - Rotate clockwise for loudness.

Squelch (SQ) Control - Quiets the receiver when signals are not being received and allows quiet standby operation. It operates only in the receive mode and does not affect the receiver volume. Rotate the control clockwise until the receiver is just quieted when no signal is being received. Incoming signals will automatically release the squelch. Careful adjustment is necessary. Setting the control too far clockwise will not allow weaker signals to release the squelch.

Meter - Transmit: Indicates battery voltage
Receive: Indicates signal strength

Telescoping Antenna - Pull the antenna up for transmitting or receiving.

External Antenna Jack - An HMB plug connector is required for this jack.

Transmit/Receive - Depress this button to transmit. Release it to receive.

2.2 OPERATING INSTRUCTIONS

2.2.1 To Receive:

1. Rotate the VOL control clockwise and adjust for a comfortable listening level.

2. Set the CHANNEL selector to the desired operating channel and readjust the VOL control as necessary.

2.2.1 To Receive (cont)

3. Adjust the Squelch control clockwise slowly until the background noise is just quieted. This should be done when there are no signals being received. It is important that this control be adjusted just to the threshold point so that weak signals will still be audible. When a transmission is received, it will release the squelch circuit, allowing the signal to be heard.

2.2.2 To Transmit:

1. Select the desired channel and listen carefully to assure that it is not busy. If it is busy, you will hear voices or an intermittent busy tone for some Marine Operator channels. Do not interrupt unless an emergency situation exists.

2. If the channel is clear, press the push-to-talk button on the side of the radio to activate the transmitter. Announce the name of the craft you are calling and its call letters followed by the name of your craft and your call letters. Release the push-to-talk button to receive a reply. At the end of the conversation, announce that you are signing of and again give the name and call letters of your craft.

Your transmitter is in operation only when the push-to-talk button is depressed and only then can others hear you. The receiver functions only when the button is released, and only then can you hear others.

2.3 BATTERY REQUIREMENT

Eight AA penlight cells (alkaline last longer than standard dry cells) must be installed in the battery pack included with the radio.

A heavy duty rechargeable battery pack is available as an option. For best results, recharge the rechargeable battery pack after about 14 hours of continuous use, or when the voltage at the terminal of the pack reaches 10V.

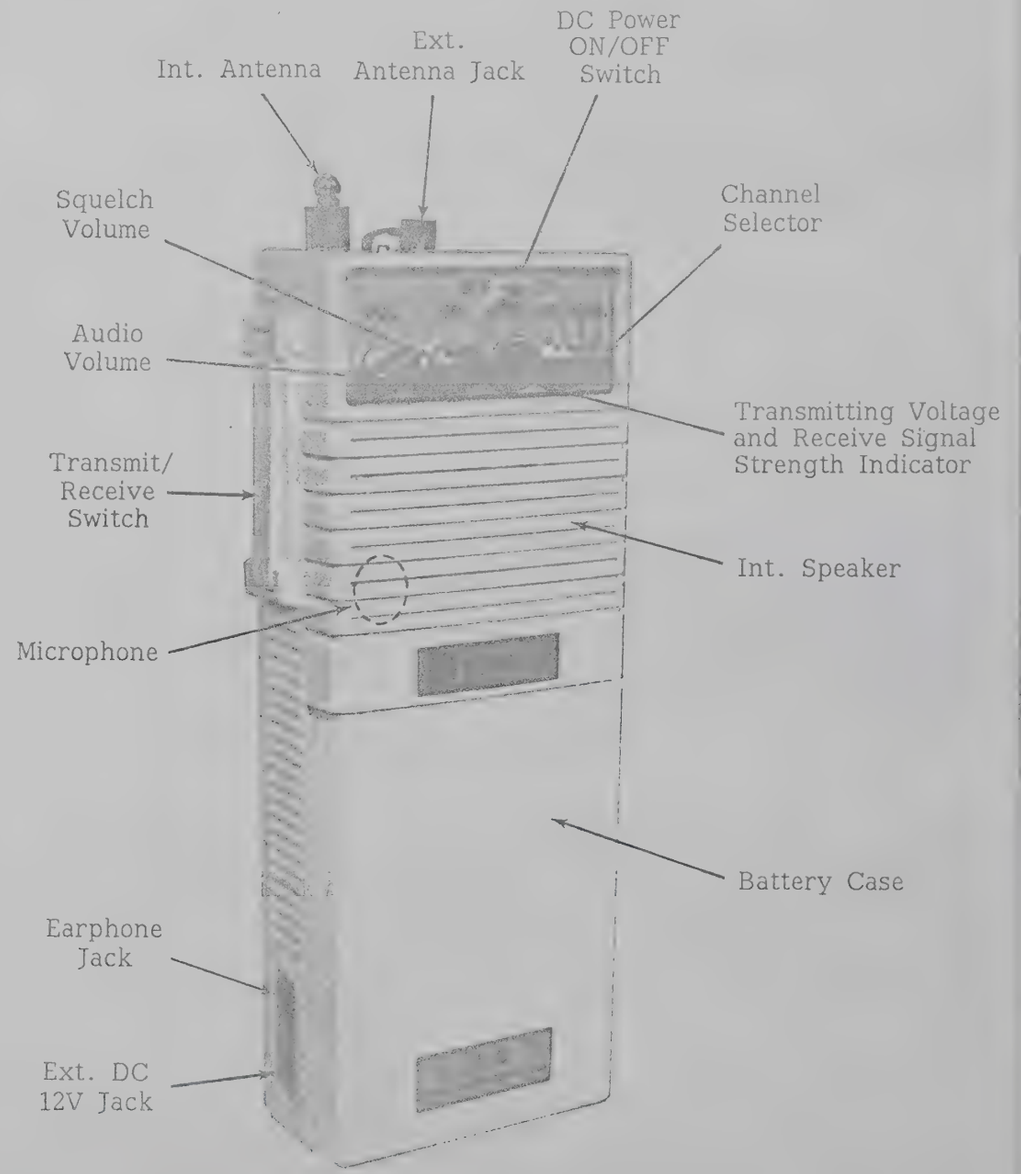


Figure 2-1 Operator Controls and Indicators

SECTION 3

RADIOTELEPHONE SERVICES

3.1 BASIC RADIOTELEPHONE SERVICE

Radiotelephone communication capability provides important benefits of safety and convenience. It is possible to call, or be called by, the Coast Guard or other vessels within range.

3.2 GETTING ON THE AIR

Before a vessel can lawfully transmit any message, with or without the assistance of a Marine Telephone Operator, the FCC requires that the following be on board:

1. A valid ship's radiotelephone station license
2. A radiotelephone operator with valid license or permit
3. A radiotelephone station log book

Federal Communication Commission regulations prohibit the use of profane language, and establish other reasonable controls. All persons aboard a vessel who will be using its communications equipment should be familiar with these and with approved operating procedures. Frequencies are shared with other boatmen. Contact should be kept brief so that all may have an equal opportunity to transmit and receive messages.

3.3 TECHNICAL REQUIREMENTS

The Telephone Company (or independent common carrier) operates shore-based radio stations for interconnection with the telephone network. It does not rent, lease or sell radiotelephone equipment for use aboard ship. Such equipment is owned and maintained by the boat owner or, in some cases, by a maritime radio operating company. The selection, installation, and maintenance of a shipboard radio station is highly technical and should be entrusted only to licensed, reliable marine radio service technicians.

The owner's service requirements and the operating area will determine the type of marine telephone service and the specific installation needed. Transmitters must meet the requirements set forth in the Regulations applicable in the country in which the ship is registered. Vessels of United States registry must conform to the regulations of the FCC.

3.4 REGISTER WITH THE COAST STATION

If regular use of Public Marine Radiotelephone Service is planned, it is important to register with the owner of the coast station serving the primary area of operation. Registration with Bell System stations is free. It provides the coast station with billing information for calls, and saves the air time necessary to transmit this information on each call.

For information on Bell System Marine services, or to register a vessel, call the Telephone Company representative in your area.

Atlanta, GA	404-877-3895	Milwaukee, WI	414-350-8870
Baltimore, MD	301-393-1036	Montreal, Canada	514-870-7189
Birmingham, AL	205-321-8509	Newark, NJ	201-649-2014
Boston, MA	617-743-4035	New Orleans, LA	504-581-7337
Charleston, SC	803-722-9011	New York, NY	212-564-0410
Charlotte, NC	704-372-9456		212-393-7394
Chicago, IL	312-727-1574	Norfolk, VA	804-424-9911
Cincinnati, OH	513-397-3431	Omaha, NB	402-422-8656
Cleveland, OH	216-822-4840	Philadelphia, PA	215-466-4648
Detroit, MI	313-354-9550	Portland, OR	503-224-6261
Houston, TX	713-521-6355	San Francisco,CA	415-986-5216
	713-521-7708		415-442-2262
Indianapolis, IN	317-630-1697	Seattle, WA	206-345-2341
Jacksonville, FL	904-353-2315	Washington, DC	202-392-3682
Los Angeles, CA	213-744-1616		202-637-9900
Miami, FL	305-379-0745	Wilmington, NC	919-763-4675
	305-350-8026		

NOTE

Keep the Telephone Company informed of any changes that affect your registration.

3.5 MARINE RADIOTELEPHONE

The Bell System and numerous independent common carriers maintain a network of marine radio stations strategically located along the coastal waters and major inland waterways of the 48 contiguous states of the U.S. Stations are generally operated around the clock.

3.5.1 VHF Service

1. Public Class III-B Coast Stations

   This service offers reliable operation with good transmission quality over distances of 20 to 50 miles, using FM with channels in the 156 MHz to 162 MHz range. Antenna height and equipment quality are the primary factors that determine communication range.

2. VHF Channels

   There are 29 noncommercial VHF channels available in the United States. They are grouped into categories for specific uses so that maximum utilization with minimum interference can be attained. A listing by category may be found in Table 3-1.

   Channels for use only by commercial vessels are: 7, 8, 10, 11, 18, 19, 67, 77, 79, 80, and 88. Channels for International use only are: 1, 2, 3, 4, 5, and 78.

3. Placing Calls on VHF/Ship-to-Shore

   a. Listen to verify that channel of desired station is not busy.
   b. When channel is clear, call desired station and announce your vessel name and call sign - repeat at intervals until Operator answers.
   c. When the Marine Operator answers, say: "This is (Ship Call Signal), the telephone billing number is.....". If there is no telephone billing number, state caller's name, ship's name and address in the port of registry.
   d. Finish up with the city and telephone number being called. Proceed thereafter as directed.
   e. At the end of the conversation, repeat ship's name and call sign and sign off with "clear" or "out".

4. Placing Shore-to-Ship Calls

   a. Call the local telephone operator and ask for the Marine Operator.
   b. Give the Marine Operator the name of the ship being called, its call sign, location, and selective signaling code number (if applicable). Proceed thereafter as directed.

5. Receiving Shore-to-Ship Calls

To receive public coast station calls, a receiver must be in operation on the proper channel.

When calling on VHF, Bell System coast stations will generally call on their assigned channel frequency.

On coastal harbor frequencies, Bell System coast stations normally call on a working channel of the coast station, but will call on the distress frequency, Channel 16 (156.8 MHz), when requested to do so by the calling party.

Since it is mandatory for commercial operators to maintain a watch on Channel 16 (156.8 MHz), many commercial operators carry an additional receiver tuned to a working frequency of their area coast station. This enables them to receive a high percentage of calls on the first attempt.

When you hear your boat called, answer as follows: (Name of coast station that called) "This is (Name of your vessel and call sign), Over". Proceed thereafter as directed.

6. Ship-to-Ship Direct

Direct ship-to-ship contacts are originated on the distress calling and safety frequency - Channel 16 (156.8 MHz)

a. On Channel 16, monitor to establish that no other communications will be disrupted, especially rescue or safety. Give the name of the vessel being called, and the name and call sign of the calling vessel.
b. When the called vessel answers, it should suggest an intership frequency on which to complete the conversation. Conversations should be limited to 3 minutes except in emergencies.
c. When the call is complete, sign off with vessel name and call sign. You may not call the same boat again for at least 10 minutes.
d. Return your receiver to distress, safety, and calling, Channel 16.

3.6 DISTRESS, URGENCY AND SAFETY MESSAGES

If the radiotelephone is turned on, and not in use, it should be monitoring the calling and safety frequency (Channel 16). This channel is monitored 24 hours a day by the Coast Guard and most commercial shore stations. If help is needed, it can be on its way in moments from the Coast Guard and other vessels in the area.

Distress, urgency and safety messages are identified by a code word at the beginning of each message. This word indicates the priority of the message.

3.6.1 Distress Signal: MAYDAY

Used only if there is an immediate danger of loss of life or property. MAYDAY has priority over all other communications.

1. If a MAYDAY is Heard

Immediately discontinue any transmission. Note the details of the message in the radio log immediately. A call to relay information or render assistance may be received. Having the facts may make it possible to help save a vessel or a life.

Unless you are in a position to render assistance and are requested to do so, or you are the only receiver of the call, do not make any transmissions on this channel until the MAYDAY condition is lifted by the Coast Guard.

2. To Make a MAYDAY Call

a. Switch to Channel 16 (156.8 MHz)

NOTE

Because the primary purpose of the channel is to summon help, it is likely that an immediate response will be received. If not, repeat the message. If still no reply, transmit on any other available frequency until contact is made.

b. Speaking slowly and distinctly, say "MAYDAY, MAYDAY, MAYDAY. This is...." giving the name of your vessel and call sign three times. Then continue with the distress message, as follows, still speaking slowly and distinctly.
c. Name of the calling vessel.
d. Position (or best estimate).
f. Description of vessel (type, color, length, number of persons aboard, etc.).
g. Indicate end of message by saying "Over".

3.6.2 Urgency Signal: PAN

Used when the safety of a vessel or person is in jeopardy. "Man overboard" messages are sent with this urgency signal. PAN has priority over all other communications with the exception of distress traffic.

3.6.3 Safety Signal: SECURITY

Used for messages concerning the safety of navigation and transmission of important meteorological warnings.

3.7 WEATHER BROADCASTS

Coast Guard stations transmit weather information in many areas. Local frequencies and schedules may be obtained from the nearest Environmental Science Services Administration (ESSA) office. The U.S. Weather Bureau broadcasts current weather on channels W1 (162.55 MHz), W2 (162.40 MHz), and W3 (162.475 MHz). The Canadian weather braodcast frequency is 161.650 MHz.

At some shore stations, the Marine Operator broadcasts weather information. The Marine Operator may be consulted for channels used and time schedule of broadcasts. Commercial braodcasting stations generally braodcast weather reports and forecasts as part of their news coverage.

NOTE

No prudent boatman ventures out of port without the best available knowledge of weather conditions and possible changes. Your radiotelephone can help you obtain this important information.

3.8 KEEPING THE LOG

NOTE

Radiotelephone logs must be retained for at least one year, and for three years if they contain entries concerning marine disaster or distress. This period may be longer if an investigation is underway or pending.

The FCC requires the following entries in a radiotelephone log each day underway:

1. Name of vessel.
2. Vessel's call sign.
3. Operator's signature.
4. Date and listening time on Channel 16 (156.8 MHz) using the 24 hour clock.
5. All distress (MAYDAY) messages heard or transmitted.
6. All urgency (PAN) and safety (SECURITY) messages transmitted.
7. Distress, urgency, and safety messages should be logged in as much detail as possible, including date, time of day, operating frequencies, vessel's name and position, and nature of emergency.
8. All installation, service, and maintenance details that affect the operation of the transmitter must be entered by the licensed technician performing such work, including his address and the class, serial number and expiration date of his license.

3.9 PHONETIC ALPHABET

To help make call letters more clearly understood, and to assist in spelling out similar-sounding or unfamiliar words, radiotelephone users usually employ the international phonetic alphabet, as shown below.

PHONETIC ALPHABET

A - ALPHA	J - JULIET	S - SIERRA
B - BRAVO	K - KILO	T - TANGO
C - CHARLIE	L - LIMA	U - UNIFORM
D - DELTA	M - MIKE	V - VICTOR
E - ECHO	N - NOVEMBER	W - WHISKEY
F - FOXTROT	O - OSCAR	X - X-RAY
G - GOLF	P - PAPA	Y - YANKEE
H - HOTEL	Q - QUEBEC	Z - ZULU
I - INDIA	R - ROMEO	

RULES TO REMEMBER

YOUR RADIO CAN MEAN YOUR SAFE ARRIVAL - USE IT WITH RESPECT.

The following are some important points of proper usage recommended by the Radio Technical Commission for Marine Services, Washington, D.C. Numbers in parentheses refer to paragraphs in FCC Rules, Part 83.

BE SURE TO GIVE NAME AND POSITION OF VESSEL.

Emergency Situations

Distress	MAYDAY-MAYDAY-MAYDAY
Urgency message concerning safety of vessel or person(s)	PAN-PAN-PAN
Safety of navigation or important weather information	SECURITY-SECURITY-SECURITY

1.	Maintain Your Watch	Listen to channel 16 when not in communication with another vessel (FCC Rules Part 83.223)
2.	Listen Before You Talk	Avoid interference with calls in progress (83.181)
3.	Identify Your Vessel	Give your call sign and vessel name at beginning and end of each communication (83.364)).
4.	Make Calls Correctly	Call other vessels on channel 16 then switch to intership channel (83.366). Call public shore stations, in general, on an appropriate working channel (83.366).
5.	Use Channels Properly	Channel 16 for emergencies and brief calls and replies (83.353). Intership (channel 6) for safety, operational or business communications (83.358).
6.	Watch Your Language	Use of profane or obscene language is a criminal offense.
7.	Be Brief At All Times	Limit calls to 30 seconds; Conversations to 3 minutes (83.366).
8.	Keep An Accurate Log	Make entries as required by (83.366).
9.	Have Documents Handy	Ship Station License: Operator License or permit; Part 83 of FCC Rules; Log Book (83.3670).

If both VHF and MF (single sideband) radiotelephones are installed, VHF must be used whenever within VHF range. This is required by FCC regulations.

If you hear a MAYDAY call, respond only if in a position to render assistance or relay the distress message.

False distress signals are prohibited. Violation, under FCC regulations, may result in a maximum fine of $10,000 and imprisonment up to two years.

Keep your radiotelephone equipment in good working order. Have it checked periodically by a qualified, licensed technician.

Radiotelephone messages, like telephone conversations, are private. It is unlawful to make use of any information not intended for you.

SECTION 4

THEORY OF OPERATION

4.1 RECEIVER

The receiver is a dual-conversation superheterodyne, receiving signals from 156.275 to 163.275 MHz on six channels. The operating channel is determined by channel selector switch S003 which provides the first local oscillator frequency. A variable squelch circuit is included to quiet the receiver between transmissions.

In the receive mode, 12 VDC is supplied to IC201, TR212, and the crystal oscillator PC board. The received signal passes through the PTT switch, S002, to the first RF amplifier, FET201. The amplified RF signal then goes to the second RF amplifier, FET202. From FET202 the amplified RF is applied to the first receiver mixer, FET203.

When S003 is turned to any channel, it selects both the transmit crystal and the receive crystal for that particular channel. For example, when channel one is selected, the operating frequency of crystal X201 is applied to the first oscillator, TR201. The output of TR201, 48.5333 MHz, is applied to the base of multiplier TR202 which multiplies the frequency three times to 145.5999 MHz. The output of TR202 is applied to the first mixer, FET203, along with the received RF signal. After mixing and converting, a 10.7 MHz first IF signal is yielded. The IF signal is passed through a 10.7 MHz bandpass filter, BPF-1, to eliminate any spurious noise, and is then applied to the second mixer, FET204.

The second oscillator, composed of TR203 and X207, generates a frequency of 10.245 MHz or 11.155 MHz. This frequency is applied to FET204 along with the first IF, for mixing and converting. The output of FET204 is a 455 kHz second IF. The second IF is then passed through a ceramic filter, BPF-2, and is applied to the first, second, and third IF amplifiers, TR204, 205 and 206. The amplified second IF signal is then applied to the limiter, TR207. From the limiter the signal is passed to amplifier TR208, and then to discriminator DISC201. The detected audio signal next passes through volume control, VR001, and is applied to the audio amplifier, IC201. The amplified audio signal is then applied to the speaker.

In the absence of signals, high frequency noise passes through the squelch control, VR002, and is applied to the first noise amplifier, TR209. The amplified noise is applied to the second noise amplifier, TR210, then to the noise detector, D209 and D210. The resulting DC voltage is applied to the DC switch, TR211, and turns it on. When TR211 turns on, it grounds the

bias circuit of audio amplifier IC201, and turns it off until an audio signal is received. This will cause IC201 to turn back on.

4.2 TRANSMITTER

When the PTT switch, S002, is pushed, the receiver is disconnected from the antenna and power is disconnected from the receiver voltage stabilizer, TR212. Power is supplied through S002 to the transmitter voltage stabilizer, TR113, and then to the various components of the transmitter. When the crystal for 156.3 MHz is inserted in the channel 1 crystal holder, the crystal, in conjunction with the transmitter oscillator, RT101, will generate a frequency of 13.025 MHz. This frequency is applied to one side of the phase modulator, D107 and D108.

At the same time, an audio signal from the microphone is applied to the first and second transmit audio amplifiers, TR109 and TR110. The amplified audio is then applied to the audio clipper, D111 and D112. The clipped audio is applied to the third transmit audio amplifier, TR111. The amplified audio goes through the low pass filter, TR112, for pre-emphasis shaping.

The audio is applied to the phase modulator, D107 and D108, where it is used to modulate the oscillator frequency from oscillator TR101. The output signal from the phase modulator, D107 and D108, is equivalent to a frequency-modulated signal because of the pre-emphasized audio supplied by TR112. The modulated signal is then applied to the first multiplier, TR102, where it is multiplied three times to yield a frequency of 39.075 MHz. The 39.075 MHz signal goes to the second multiplier, TR103, where it is multiplied two times for a frequency of 78.15 MHz. From TR102, the signal goes to the third multiplier, TR104, and is multiplied twice for a final frequency of 156.3 MHz.

The 156.3 MHz phase-modulated signal is then applied to the pre-driver, TR105, where it is amplified. The amplified signal is then applied to driver TR106. From TR106 the signal is applied to power amplifier TR107. TR107 is a current amplifier and raises the output signal sufficiently to give 1.0 watt output at the antenna.

The final output signal is passed through the tank circuit composed of C145 to C149, VC108, VC109 and L113 to L115. It is then applied to the antenna.

An automatic power control, TR108, is provided to prevent more than 1 watt of power from being transmitted. A degenerative feedback path from the collector of the power amplifier, TR107, to the APC, TR108, allows excessive power output to be detected by D109 and D110, which is then fed to the base of TR108. TR108 acts as a bias controller for TR104, TR105 and TR106. When excessive power is detected, TR108 lowers the bias voltage on the affected amplifiers which lowers their outputs.

When in the transmit mode, the front panel meter indicates battery strength. In the receive mode, the meter indicates relative received signal strength. In transmit, the battery line voltage is detected by D115 and is applied to the meter. In receive, the amplified IF signal is taken off the collector of TR206 and detected by meter detectors D213 and D214. The detected voltage is then amplified by DC amplifier TR213 whose output is applied to the meter.

The voltage stabilizers, TR113 for the transmit circuit, and TR212 for the receive circuit, are automatic voltage regulators for the various components. The zener diodes in their base circuits provide reference voltages for the regulators.

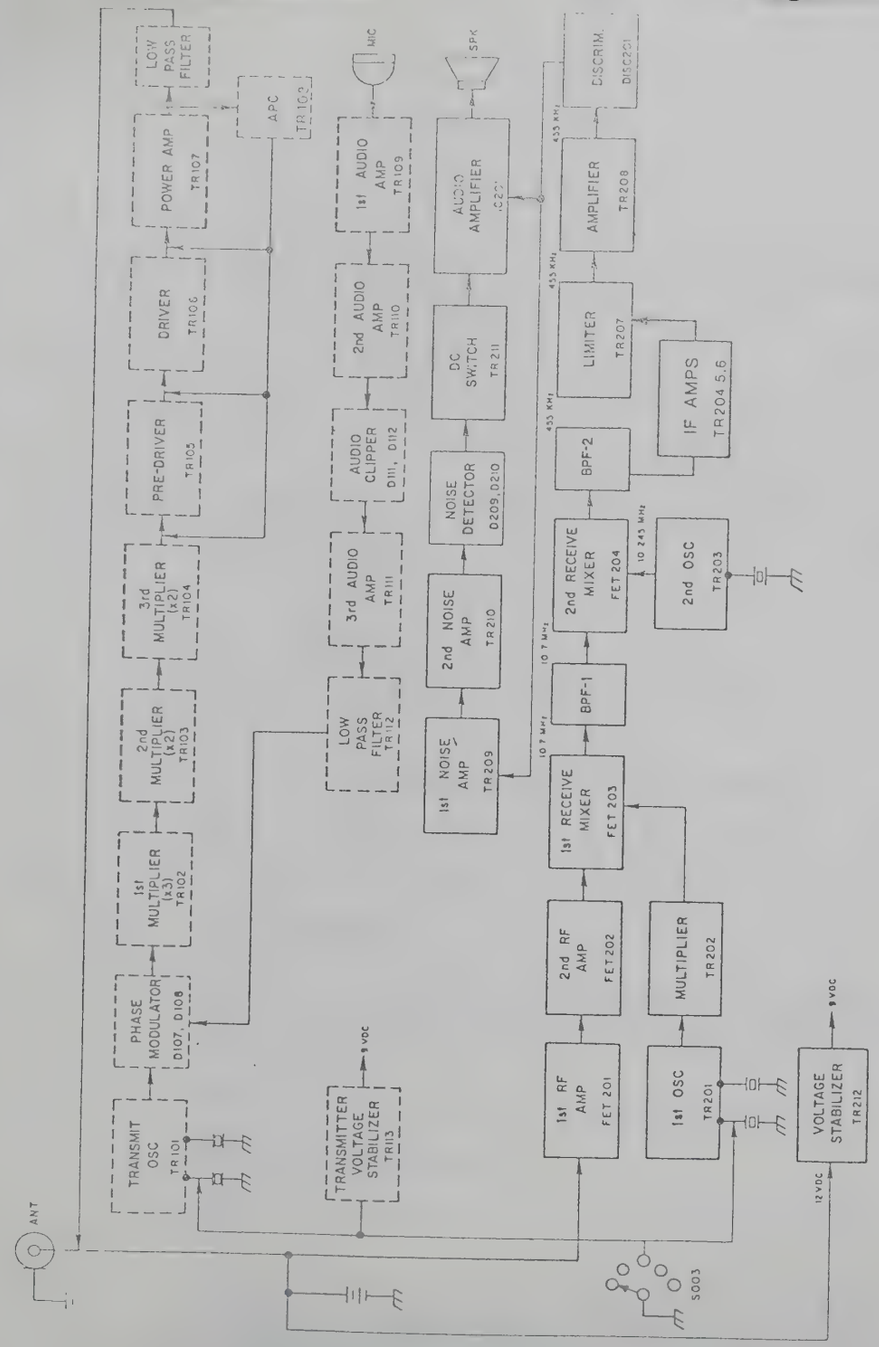


Figure 4-1 Block Diagram, Model AF6 Radiotelephone

SECTION 5

MAINTENANCE

5.1 GENERAL

These procedures must be followed to properly align the AF6 Radiotelephone. Alignment should not undertaken unless the technician has adequate test euqipment and a full understanding of the circuitry of the transceiver.

The procedures are divided into two main sections: Receiver Alignment and Transmitter Alignment. Refer to paragraph 5.2 for a complete list of tools and equipment.

These procedures assume that voltages are present at all points. If not, troubleshoot before continuing.

> WARNING
> DO NOT USE MERCURY BATTERIES. THE POTENTIAL DANGER IS TOO GREAT. THE USE OF THE CHARGER WITH MERCURY, ALKALINE OR DRY CELL BATTERIES COULD RESULT IN A VIOLENT EXPLOSION. USE THE CHARGER ONLY WITH A RECHARGEABLE BATTERY PACK INSTALLED.

NOTE

The ferrite cores in the tuning coils are easily chipped or broken. Always use care when inserting an alignment tool in the tuning coil: insert it straight into the core.

5.2 TOOLS AND EQUIPMENT

The following tools and equipment are recommended for use in aligning the AF6 transceiver.

1. VTVM, DC and RF with a probe not to exceed 1 pF in capacitance.
2. RF power meter, 150 MHz, 2 watts, 50 ohms
3. Battery pack or 12 VDC power supply
4. Oscilloscope, 50 MHz with a 10:1 probe not to exceed 7 pF in capacitance
5. 1 kHz audio generator
6. Frequency meter or frequency counter, 150 MHz
7. Signal generator, 150 MHz, 50 ohms
8. Transformer, 600 ohms to 32 ohms

All test equipment must be properly calibrated.

NOTE

Test Voltage is 13.6 VDC.

Refer to Figure 5-1 for test equipment setup.

5.3 RECEIVER

Refer to Figures 5-3 and 5-4 for the location of components to be adjusted for receiver alignment.

5.3.1 Receiver Alignment

1. Connect an oscilloscope to the emitter of TR203.
2. Measure 0.4V peak to peak at 10.245 MHz or 11.155 MHz.
3. Connect a signal generator to the gate of FET203. The generator must be DC isolated. Set the signal generator to 10.7 MHz.

NOTE

This alignment should be performed with an extremely small signal input from the signal generator to prevent saturation of the IF stages.

4. Connect the probe of the oscilloscope to P201.
5. Alternately adjust L209, L210 and L211 until the peaks and valleys of the oscilloscope waveform are minimal and amplitude is maximum (limiting).

5.3.2 Limiter Alignment

1. Connect the oscilloscope probe to the external speaker jack J002. Connect the signal generator output, set exactly at 10.7 MHz, modulated at 1 kHz, 3 kHz deviation to the gate of FET203.
2. Adjust L212 for maximum audio sine wave output.

5.3.3 First Oscillator Alignment

1. Connect the RF probe of an RF VTVM to the gate of FET203.
2. Adjust L207 and L208 until the VTVM indication is maximum.

3. Connect the cable of the frequency counter to the gate of FET203 with a 5 pF capacitor.
4. Adjust the trimmer (VC201 through VC206) of the desired channel until the frequency reading is within ±200 Hz.

NOTE

This is best set with a modulated generator for a better sine wave output (in lieu of a zeroable discriminator).

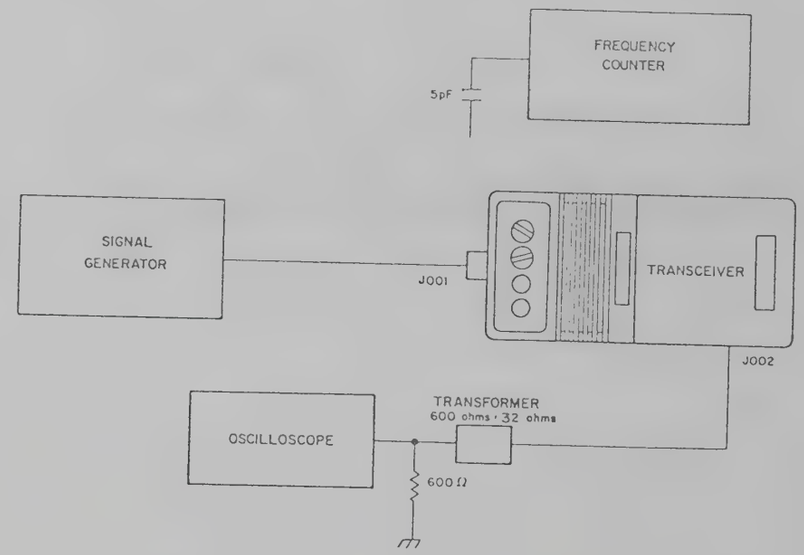


Figure 5-1 Equipment Setup, Receiver Alignment

5.3.4 RF Alignment

1. Connect the signal generator to the external antenna jack, J001, and set the signal generator to the desired frequency.
2. Connect the oscilloscope probe to P201.

5.3.4 RF Alignment (cont)

3. Adjust L201, L202, L203, L204, L205 and L206 until the output waveform is maximum.

4. Repeat the above adjustment two or three times, keeping the generator level low to prevent limiting.

5.4 TRANSMITTER ALIGNMENT

Refer to Figures 5-5 and 5-6 for the location of components to be adjusted for transmitter alignment.

5.4.1 Voltage Stabilizer Check

1. Connect the DC probe of the VTVM to the emitter of TR113.

2. Press the PTT switch and measure 9V.

5.4.2 Transmitter RF Alignment

1. Connect an oscilloscope to the base of TR102.

2. Measure 0.4V peak to peak.

3. Connect the DC probe of a VTVM to P102 and press the PTT switch.

4. Adjust L101 and L102 until the meter indication is maximum.

5. Connect the DC probe of the VTVM to P103 and adjust L103 and L104 until the meter indication is maximum.

6. Connect the probe of the VTVM to P104 and adjust L105 and L106 until the meter indication is maximum.

7. Connect the DC probe of the VTVM to P105 and adjust L107 and L108 until the meter indication is maximum.

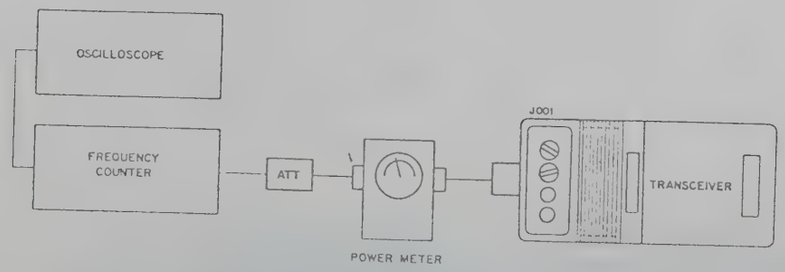


Figure 5-2 Equipment Setup, Transmitter Alignment

5.4.3 Transmitter Modulator Alignment

1. Connect an oscilloscope and deviation meter to the attenuator at the external antenna jack, J001.

2. Apply a 1000 Hz audio signal to the microphone and check the waveform.

3. The microphone preamplifier, VR101, is preset for average voice characteristics. Should excessive noise be noted in transmission, reduce the gain. If weak voice transmission occurs, increase the gain.

4. Adjust VR102 for a frequency deviation not to exceed ±5 kHz.

5.4.4 Frequency Alignment

1. Connect the cable of the frequency counter to the external antenna jack J001.

2. Adjust the desired channel frequency trimmer, VC101 through VC106, until the frequency reading is within ±200 Hz.

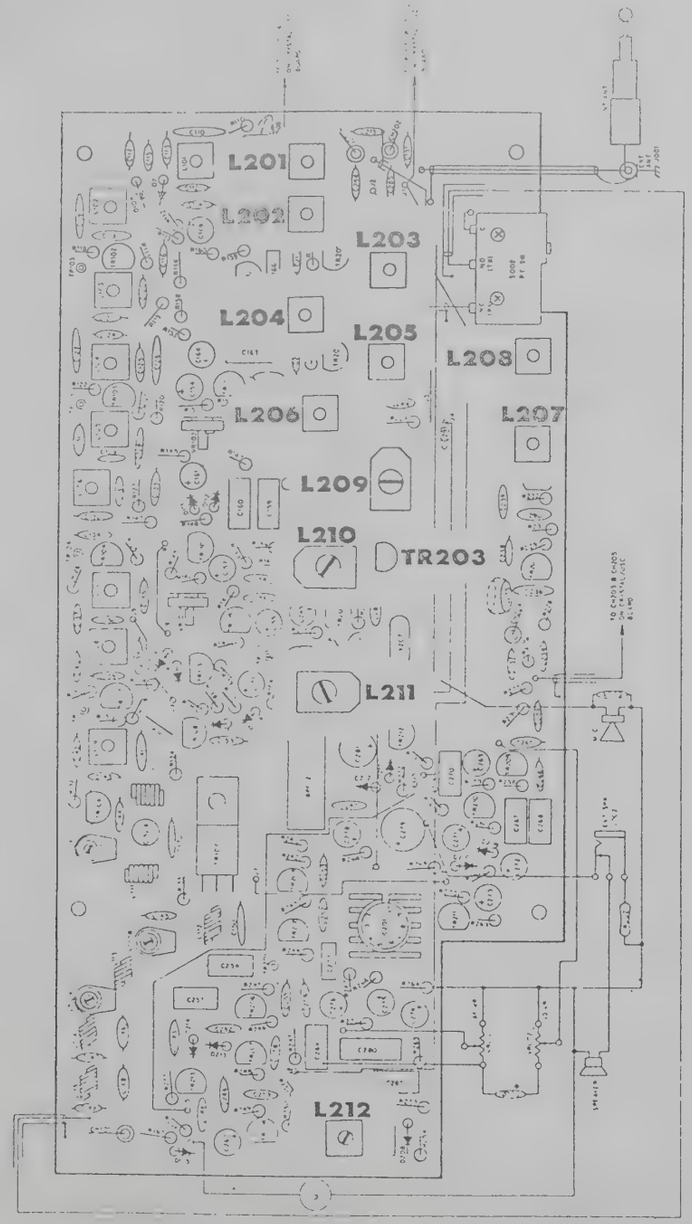


Figure 5-3 Components Adjusted for Receiver Alignment (Main PC Board)

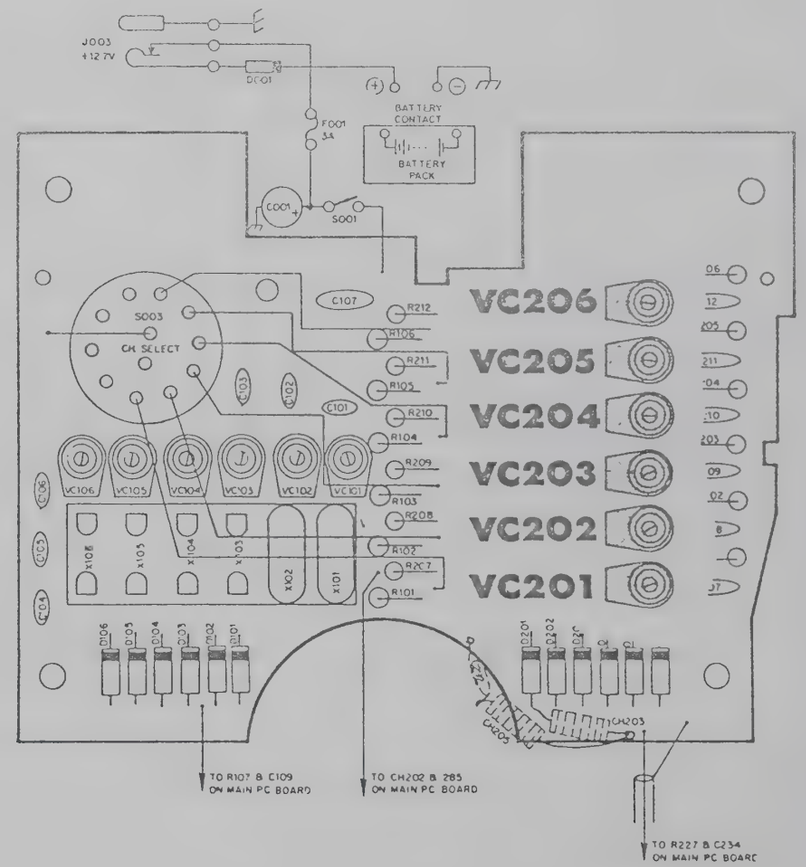


Figure 5-4 Components Adjusted for Receiver Alignment (Crystal Oscillator PC Board)

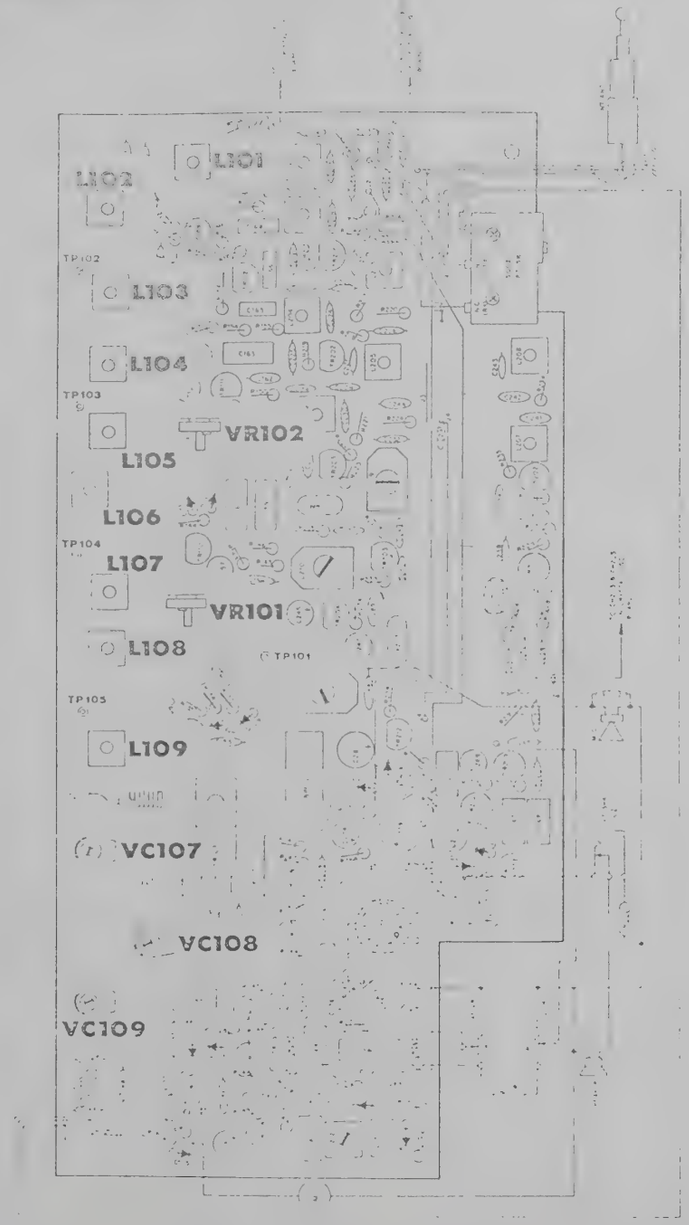


Figure 5-5 Components Adjusted for Transmitter Alignment (Main PC Board)

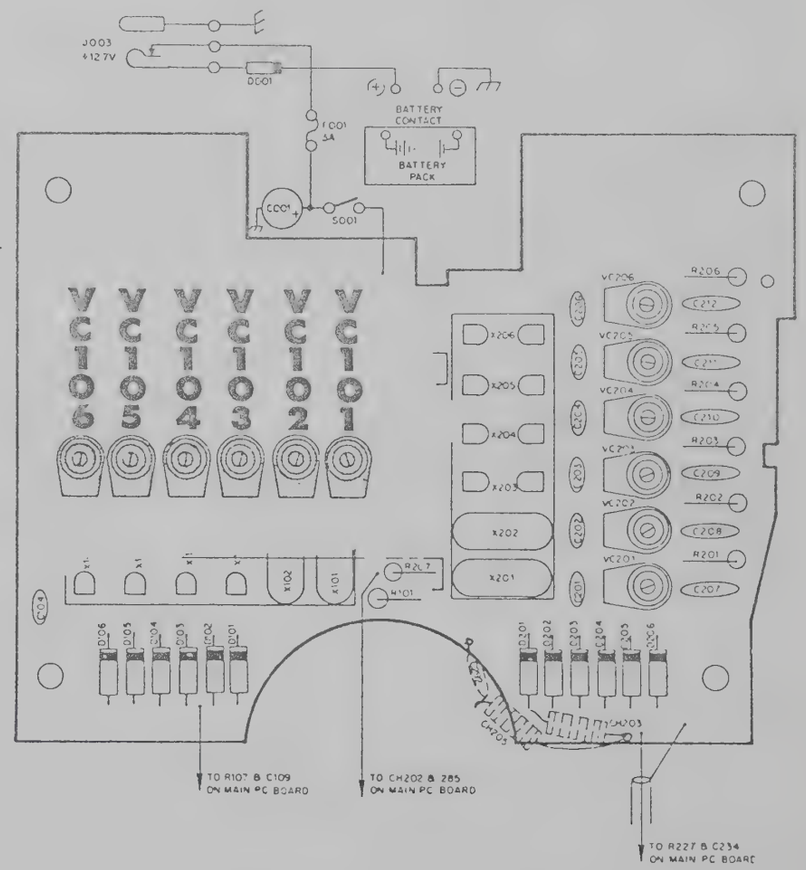


Figure 5-6 Components Adjusted for Transmitter Alignment (Crystal Oscillator PC Board)

5.5 TRANSISTOR VOLTAGE TABLE

Symbol No.	Mode	E	B	C
TR101	Rx	0	0	0
	Tx	3.2	3.8	8.2
TR102	Rx	0	0	0
	Tx	0	0	1.2
TR103	Rx	0	0	0
	Tx	0	.2	7.8
TR104	Rx	0	0	0
	Tx	1.3	.84	7.8
TR105	Rx	0	0	0
	Tx	1.5	.4	7.4
TR106	Rx	0	0	0
	Tx	3.2	2.8	7.0
TR107	Rx	0	0	0
	Tx	.2	0	13
TR108	Rx	0	0	0
	Tx	1.8	7.6	8.0
TR109	Rx	0	0	0
	Tx	1.1	.4	5.0
TR110	Rx	0	0	0
	Tx	0	.8	4.8
TR111	Rx	0	0	0
	Tx	0	.8	4.1
TR112	Rx	0	0	0
	Tx	8.8	1.8	2.8
TR113	Rx	0	0	0
	Tx	9.0	9.8	12.0
TR201	Rx	3.2	1.8	3.4
	Tx	0	0	0
TR202	Rx	1.3	8.2	1.1
	Tx	0	0	0
TR203	Rx	4.2	.14	6.5
	Tx	0	0	0
TR204	Rx	0	.7	.92
	Tx	0	0	0
TR205	Rx	3.6	3.0	4.0
	Tx	0	0	0
TR206	Rx	6.8	6.0	7.0
	Tx	0	0	0
TR207	Rx	.36	0	1.8
	Tx	0	.18	.18
TR208	Rx	3.6	4.6	.24
	Tx	.42	0	0
TR209	Rx	0	.64	1.2
	Tx	0	.4	.36
TR210	Rx	4.4	5.0	5.6
	Tx	.72	0	0
TR211	Rx	0	0	6.4

5.5 TRANSISTOR VOLTAGE TABLE (cont)

Symbol No.	Mode	E	B	C
	Tx	.36	0	0
TR212	Rx	9.0	9.8	12.0
	Tx	0	0	0
TR213	Rx	.7	.1	12.0
	Tx	.3	.44	.2

SECTION 6

PARTS LIST & SCHEMATIC

Section 6 contains the schematic diagram and parts list for the AF6. Parts having a Raytheon part number listed may be ordered through Raytheon. Parts that do not have a Raytheon part number are common items that may be obtained wherever available.

Table 6-1 AF6 Parts List (1 of 11)

Main P.C. Board

Reference Symbol	Description	Part Number
BPF201	BAND PASS FILTER (10C1KC)	983448-37
BPF202	BAND PASS FILTER (EFC-L455K11D)	983448-38
C109	1000 pF,±20%,50V,CERAMIC	
C110	150 pF,±20%,50V,CERAMIC	
C111	330 pF,±10%,125V,POLYSTYRENE	
C112	1000 pF,±10%,50V,CERAMIC	
C113	22 pF,±5%,50V,CERAMIC	
C114	1000 pF,20%,50V,CERAMIC	
C115	3 pF,50V, CERAMIC	
C116	1000 pF,±20%,50V,CERAMIC	
C117	22 pF,±5%,50V,CERAMIC	
C118	1000 pF,±20%,50V,CERAMIC	
C119	4700 pF,±20%,50V,CERAMIC	
C120	1000 pF,±20%,50V,CERAMIC	
C121	27 pF,±5%,50V,CERAMIC	
C122	(NOT USED)	
C123	(NOT USED)	
C124	3 pF,±0.25 pF,50V,CERAMIC	
C125	47 pF,±5%,50V,CERAMIC	
C126	100 pF,±5%,50V,CERAMIC	
C127	4700 pF,±20%,50V,CERAMIC	
C128	1000 pF,±20%,50V,CERAMIC	
C129	15 pF,±5%,50V,CERAMIC	
C130	2 pF,±0.25 pF,50V,CERAMIC	
C131	33 pF,±5%,50V,CERAMIC	
C132	47 pF,±5%,50V,CERAMIC	
C133	1000 pF,±20%,50V,CERAMIC	
C134	1000 pF,±20%,50V,CERAMIC	
C135	1000 pF,±20%,50V,CERAMIC	
C136	10 pF,±5%,50V,CERAMIC	
C137	1 pF,±0.25 pF,50V,CERAMIC	
C138	15 pF,±5%,50V,CERAMIC	
C139	47 pF,±5%,50V,CERAMIC	
C140	1000 pF,±20%,50V,CERAMIC	
C141	1000 pF,±20%,50V,CERAMIC	
C142	15 pF,±5%,50V,CERAMIC	
C143	27 pF,±10%,50V,CERAMIC	
C144	5 pF,±0.25 pF,50V,CERAMIC	
C145	5 pF,±0.25 pF,50V,CERAMIC	
C146	2 pF,±0.25 pF,50V,CERAMIC	
C147	15 pF,±5%,50V,CERAMIC	
C148	1 pF,±0.25 pF,50V,CERAMIC	

NOTE: All resistors are 1/8W,±5%, carbon film unless otherwise noted.

Table 6-1 AF6 Parts List (2 of 11)

Reference Symbol	Description	Part Number
C149	10 pF,±0.5 pF,50V,CERAMIC	
C150	1000 pF,±20%,50V,CERAMIC	
C151	1000 pF,±20%,50V,CERAMIC	
C152	10 uF,16V,ELECTROLYTIC	
C153	1000 pF,±20%,50V,CERAMIC	
C154	10 uF,16V,ELECTROLYTIC	
C155	1 uF,50V,ELECTROLYTIC	
C156	1000 pF,±20%,50V,CERAMIC	
C157	1 uF,50V,ELECTROLYTIC	
C158	1000 pF,±20%,50V,CERAMIC	
C159	.01 uF,±20%,50V,MYLAR	
C160	.022 uF,±20%,50V,MYLAR	
C161	1 uF,50V,ELECTROLYTIC	
C162	1000 pF,±20%,50V,CERAMIC	
C163	.015 uF,±20%,50V,MYLAR	
C164	1 uF,50V,ELECTROLYTIC	
C165	3300 pF,±20%,50V,MYLAR	
C166	3300 pF,±20%,50V,MYLAR	
C167	4700 pF,±20%,50V,MYLAR	
C168	3300 pF,±20%,50V,MYLAR	
C169	1 uF,50V,ELECTROLYTIC	
C170	1000 pF,±20%,50V,CERAMIC	
C171	10 uF,16V,ELECTROLYTIC	
C213	33 pF,±5%,50V,CERAMIC	
C214	15 pF,±5%,50V,CERAMIC	
C215	5 pF,±0.25 pF,50V,CERAMIC	
C216	1 pF,±0.25 pF,50V,CERAMIC	
C217	7 pF,±0.25 pF,50V,CERAMIC	
C218	1000 pF,±20%,50V,CERAMIC	
C219	1000 pF,±20%,50V,CERAMIC	
C220	1000 pF,±20%,50V,CERAMIC	
C221	7 pF,±0.25 pF,50V,CERAMIC	
C222	1 pF,±0.25 pF,50V,CERAMIC	
C223	7 pF,±0.25 pF,50V,CERAMIC	
C224	100 pF,±20%,50V,CERAMIC	
C225	100 pF,±20%,50V,CERAMIC	
C226	100 pF,±20%,50V,CERAMIC	
C227	7 pF,±0.25 pF,50V,CERAMIC	
C228	1 pF,±0.25 pF,50V,CERAMIC	
C229	5 pF,±0.5 pF,50V,CERAMIC	
C230	1000 pF,±20%,50V,CERAMIC	
C231	1000 pF,±20%,50V,CERAMIC	
C232	1000 pF,±20%,50V,CERAMIC	
C233	1000 pF,±20%,50V,CERAMIC	
C234	1000 pF,±20%,50V,CERAMIC	
C235	56 pF,±5%,50V,CERAMIC	

Table 6-1 AF6 Parts List (3 of 11)

Reference Symbol	Description	Part number
C236	150 pF,±5%,50V,CERAMIC	
C237	1000 pF,±20%,50V,CERAMIC	
C238	22 pF,±5%,50V,CERAMIC	
C239	1000 pF,±20%,50V,CERAMIC	
C240	(NOT USED)	
C241	18 pF,±5%,50V,CERAMIC	
C242	1 pF,±0.25 pF,50V,CERAMIC	
C243	15 pF,±5%,50V,CERAMIC	
C244	1 pF,±0.25 pF,50V,CERAMIC	
C245	1 uF,50V,ELECTROLYTIC	
C246	1000 pF,±20%,50V,CERAMIC	
C247	10 uF,16V,ELECTROLYTIC	
C248	1000 pF,±20%,50V,CERAMIC	
C249	33 pF,±5%,50V,CERAMIC	
C250	47 pF,±5%,50V,CERAMIC	
C251	2 pF,±0.25 pF,50V,CERAMIC	
C252	330 pF,±20%,50V,CERAMIC	
C253	330 pF,±20%,50V,CERAMIC	
C254	.022 uF,±20%,50V,MYLAR	
C255	330 pF,±20%,50V,CERAMIC	
C256	330 pF,±20%,50V,CERAMIC	
C257	.022 uF,±20%,50V,MYLAR	
C258	330 pF,±20%,50V,CERAMIC	
C259	330 pF,±20%,50V,CERAMIC	
C260	3.3 uF,25V,ELECTROLYTIC	
C261	1000 pF,±20%,50V,MYLAR	
C262	3.3 uF,25V, ELECTROLYTIC	
C263	1000 pF,±20%,50V,MYLAR	
C264	0.001 uF,±20%,50V,MYLAR	
C265	330 pF,±20%,50V,CERAMIC	
C266	330 pF,±20%,50V,CERAMIC	
C267	2200 pF,±20%,50V,MYLAR	
C268	1000 pF,±20%,50V,MYLAR	
C269	3.3 uF,25V,ELECTROLYTIC	
C270	2200 pF,±20%,50V,MYLAR	
C271	1 uF,50V,ELECTROLYTIC	
C272	3.3 uF,25V,ELECTROLYTIC	
C273	3.3 uF,25V,ELECTROLYTIC	
C274	10 uF,16V,ELECTROLYTIC	
C275	1 uF,50V,ELECTROLYTIC	
C276	10 uF,16V,ELECTROLYTIC	
C277	1000 pF,±20%,50V,MYLAR	
C278	3.3 uF,25V,ELECTROLYTIC	
C279	100 uF,16V,ELECTROLYTIC	
C280	.047 uF,±20%,50V,MYLAR	
C281	47 uF,16V,ELECTROLYTIC	

Table 6-1 AF6 Parts List (4 of 11)

Reference Symbol	Description	Part Number
C282	33 pF,±5%,50V,CERAMIC	
C283	1000 pF,±20%,50V,CERAMIC	
C284	1000 pF,±20%,50V,CERAMIC	
C285	1000 pF,±20%,50V,CERAMIC	
C286	82 pF,±5%,50V,CERAMIC	
C287	1000 pF,±20%,50V,CERAMIC	
C288	1000 pF,±20%,50V,CERAMIC	
C289	1000 pF,±20%,50V,CERAMIC	
C290	1000 pF,±20%,50V,CERAMIC	
C291	1000 pF,±20%,50V,CERAMIC	
C292	1000 pF,±20%,50V,CERAMIC	
CH101	COIL,CHOKE (FA4U-1277)	983448-34
CH201	COIL,CHOKE (FA4U-1277)	983448-34
CH202	COIL,CHOKE (FA4U-1277)	983448-34
CH203	COIL,CHOKE (FA4U-2904B)	983448-35
CH204	COIL,CHOKE (FA4U-1936B)	983448-36
CH205	COIL,CHOKE (FA4U-2904B)	983448-35
D107	DIODE,SILICON (1S2689B)	983448-40
D108	DIODE,SILICON (1S2689B)	983448-40
D109	DIODE,SILICON (MA150)	983448-41
D110	DIODE,SILICON (MA150)	983448-41
D111	DIODE,SILICON (MA150)	983448-41
D112	DIODE,SILICON (MA150)	983448-41
D113	DIODE,SILICON (MA150)	983448-41
D114	DIODE,ZENER (XZ090)	983448-42
D115	DIODE,SILICON (MA150)	983448-41
D207	DIODE,SILICON (MA150)	983448-41
D208	DIODE,SILICON (MA150)	983448-41
D209	DIODE,SILICON (MA150)	983448-41
D210	DIODE,SILICON (MA150)	983448-41
D211	DIODE,ZENER (XZ090)	983448-42
D212	DIODE,SILICON (MA150)	983448-41
D213	DIODE,SILICON (MA150)	983448-41
D214	DIODE,SILICON (MA150)	983448-41
DISC201	CERAMIC DISC (455D)	983448-39
FET201	FIELD EFFECT TRANS. (2SK83)	983448-43
FET202	FIELD EFFECT TRANS. (2SK83)	983448-43
FET203	FIELD EFFECT TRANS. (2SK83)	983448-43
FET204	FIELD EFFECT TRANS. (2SK83)	983448-43
IC201	ANALOG IC (AN274)	983448-53
L101	RF COIL (FA4U-3179	983448-24
L102	RF COIL (FA4U-3179)	983448-24
L103	RF COIL (FA4U-3180)	983449-25
L104	RF COIL (FA4U-3180)	983448-25
L105	RF COIL (FA4U-3181)	983448-26
L106	RF COIL (FA4U-3181)	983448-26

Table 6-1 AF6 Parts List (5 of 11)

Reference Symbol	Description	Part Number
L107	RF COIL (FA4U-3182)	983448-27
L108	RF COIL (FA4U-3182)	983448-27
L109	RF COIL (FA4U-3182)	983448-27
L110	RF COIL (FA4U-3183)	983448-28
L111	RF COIL (FA4U-3183)	983448-28
L112	RF COIL (FA4U-3183)	983448-28
L113	RF COIL (FA4U-3184)	983448-29
L114	RF COIL (FA4U-3184)	983448-29
L115	RF COIL (FA4U-3184)	983448-29
L201	RF COIL (FA4U-2190)	983448-30
L202	RF COIL (FA4U-2190)	983448-30
L203	RF COIL (FA4U-2190)	983448-30
L204	RF COIL (FA4U-2190)	983448-30
L205	RF COIL (FA4U-2190)	983448-30
L206	RF COIL (FA4U-2190)	983448-30
L207	RF COIL (FA4U-2265B)	983448-31
L208	RF COIL (FA4U-2190)	983448-30
L209	IF COIL (EIF-7S752C)	983448-32
L210	IF COIL (EIF-7S752C)	983448-32
L211	IF COIL (EIF-7S752C)	983448-32
L212	IF COIL (FA4U-2643C)	983448-33
R107	2.2k	
R108	10k	
R109	10k	
R110	560	
R111	100	
R112	1k	
R113	1k	
R114	47k	
R115	100	
R116	(NOT USED)	
R117	47k	
R118	470	
R119	3.3k	
R120	4.7k	
R121	47k	
R122	470	
R123	100	
R124	5.6k	
R125	33k	
R126	220	
R127	(NOT USED)	
R128	4.7k	
R129	47k	
R130	47	
R131	3.3k	

Table 6-1 AF6 Parts List (6 of 11)

Reference Symbol	Description	Part Number
R132	1k	
R133	47	
R134	1k	
R135	15	
R136	47,SOLID	
R137	10	
R138	1k	
R139	22k	
R140	33k	
R141	100k	
R142	2.2k	
R143	33k	
R144	150k	
R145	2.2k	
R146	33k	
R147	3.3k	
R148	22k	
R149	3.3k	
R150	10k	
R151	47k	
R152	2.2k	
R153	33k	
R154	22k	
R155	100	
R156	10k	
R157	22k	
R158	22k	
R159	82	
R160	390	
R161	6.8k	
R162	12k	
R163	12k	
R164	2.2k	
R213	100k	
R214	100k	
R215	2.2k	
R216	100	
R217	100k	
R218	100k	
R219	2.2k	
R220	100	
R221	33k	
R222	100k	
R223	2.2k	
R224	100	
R225	4.7k	

Reference Symbol	Description	Part Number
R226	1k	
R227	2.2k	
R228	10k	
R229	10k	
R230	560	
R231	10k	
R232	10k	
R233	470	
R234	3.3k	
R235	47	
R236	1.5k	
R237	10k	
R238	1k	
R239	150k	
R240	4.7k	
R241	220	
R242	47k	
R243	3.3k	
R244	47k	
R245	3.3k	
R246	47k	
R247	3.3k	
R248	47k	
R249	1k	
R250	68k	
R251	1.5k	
R252	5.6k	
R253	15k	
R254	15k	
R255	4.7k	
R256	560	
R257	(NOT USED)	
R258	220k	
R259	4.7k	
R260	220k	
R261	4.7k	
R262	2.2k	
R263	15k	
R264	47k	
R265	220	
R266	33k	
R267	10k	
R268	1.8k	
R269	33k	
R270	22k	
R271	3.3	

Table 6-1 AF6 Parts List (8 of 11)

Reference Symbol	Description	Part Number
R272	680	
R273	15k	
R274	1k	
TR101	TRANSISTOR (2SC829)	983448-44
TR102	TRANSISTOR (2SC829)	983448-44
TR103	TRANSISTOR (2SC1047)	983448-45
TR104	TRANSISTOR (2SC1047)	983448-45
TR105	TRANSISTOR (2SC1047)	983448-45
TR106	TRANSISTOR (2SC2053)	983448-46
TR107	TRANSISTOR (2SC1970)	983448-47
TR108	TRANSISTOR (2SA719)	983448-48
TR109	TRANSISTOR (2SC828)	983448-49
TR110	TRANSISTOR (2SC828)	983448-49
TR111	TRANSISTOR (2SC828)	983448-49
TR112	TRANSISTOR (2SC828)	983448-49
TR113	TRANSISTOR (2SC828)	983448-49
TR201	TRANSISTOR (2SC1047)	983448-45
TR202	TRANSISTOR (2SC1047)	983448-45
TR203	TRANSISTOR (2SC829)	983448-44
TR204	TRANSISTOR (2SC829)	983448-44
TR205	TRANSISTOR (2SC829)	983448-44
TR206	TRANSISTOR (2SC829)	983448-44
TR207	TRANSISTOR (2SC829)	983448-44
TR208	TRANSISTOR (2SC829)	983448-44
TR209	TRANSISTOR (2SC828)	983448-49
TR210	TRANSISTOR (2SC828)	983448-49
TR211	TRANSISTOR (2SC828)	983448-49
TR212	TRANSISTOR (2SC828)	983448-49
TR213	TRANSISTOR (2SC828)	983448-49
VR101	500,POTENTIOMETER	983448-22
VR102	5k,POTENTIOMETER	983448-23
VC107	20 pF,50V,VARIABLE CAP	983448-17
VC108	20 pF,50V,VARIABLE CAP	983448-17
VC109	20 pF,50V,VARIABLE CAP	983448-17
X207	CRYSTAL RESONATOR (FA4D10291C)	983448-21

Crystal Oscillator P.C. Board

C101	33 pF,±0.5 pF,50V,CERAMIC
C102	33 pF,±0.5 pF,50V,CERAMIC
C103	33 pF,±0.5 pF,50V,CERAMIC
C104	33 pF,±0.5 pF,50V,CERAMIC
C105	33 pF,±0.5 pF,50V,CERAMIC
C106	33 pF,±0.5 pF,50V,CERAMIC
C107	100 pF,±20%,50V,CERAMIC

Table 6-1 AF6 Parts List (9 of 11)

Reference Symbol	Description	Part Number
C108	1000 pF,±20%,50V,CERAMIC	
C201	10 pF,±0.5 pF,50V,CERAMIC	
C202	10 pF,±0.5 pF,50V,CERAMIC	
C203	10 pF,±0.5 pF,50V,CERAMIC	
C204	10 pF,±0.5 pF,50V,CERAMIC	
C205	10 pF,±0.5 pF,50V,CERAMIC	
C206	10 pF,±0.5 pF,50V,CERAMIC	
C207	1000 pF,±20%,50V,CERAMIC	
C208	1000 pF,±20%,50V,CERAMIC	
C209	1000 pF,±20%,50V,CERAMIC	
C210	1000 pF,±20%,50V,CERAMIC	
C211	1000 pF,±20%,50V,CERAMIC	
C212	1000 pF,±20%,50V,CERAMIC	
D101	DIODE,SILICON (MC301)	983448-50
D102	DIODE,SILICON (MC301)	983448-50
D103	DIODE,SILICON (MC301)	983448-50
D104	DIODE,SILICON (MC301)	983448-50
D105	DIODE,SILICON (MC301)	983448-50
D106	DIODE,SILICON (MC301)	983448-50
D201	DIODE,SILICON (MC301)	983448-50
D202	DIODE,SILICON (MC301)	983448-50
D203	DIODE,SILICON (MC301)	983448-50
D204	DIODE,SILICON (MC301)	983448-50
D205	DIODE,SILICON (MC301)	983449-50
D206	DIODE,SILICON (MC301)	983449-50
R101	2.2k	
R102	2.2k	
R103	2.2k	
R104	2.2k	
R105	2.2k	
R106	2.2k	
R201	2.2k	
R202	2.2k	
R203	2.2k	
R204	2.2k	
R205	2.2k	
R206	2.2k	
R207	22k	
R208	22k	
R209	22k	
R210	22k	
R211	22k	
R212	22k	
VC101	20 pF,50V,VARIABLE CAP	983448-17
VC102	20 pF,50V,VARIABLE CAP	983448-17
VC103	20 pF,50V,VARIABLE CAP	983448-17

Table 6-1 AF6 Parts List (10 of 11)

Reference Symbol	Description	Part Number
VC104	20 pF,50V,VARIABLE CAP	983448-17
VC105	20 pF,50V,VARIABLE CAP	983448-17
VC106	20 pF,50V,VARIABLE CAP	983448-17
VC201	20 pF,50V,VARIABLE CAP	983448-17
VC202	20 pF,50V,VARIABLE CAP	983448-17
VC203	20 pF,50V,VARIABLE CAP	983448-17
VC204	20 pF,50V,VARIABLE CAP	983448-17
VC205	20 pF,50V,VARIABLE CAP	983448-17
VC206	20 pF,50V,VARIABLE CAP	983448-17
X101	CRYSTAL RESONATOR (TX)	983533-xxx
X102	CRYSTAL RESONATOR (TX)	983533-xxx
X103	CRYSTAL RESONATOR (TX)	983533-xxx
X104	CRYSTAL RESONATOR (TX)	983533-xxx
X105	CRYSTAL RESONATOR (TX)	983533-xxx
X106	CRYSTAL RESONATOR (TX)	983533-xxx
X201	CRYSTAL RESONATOR (RX)	983534-xxx
X202	CRYSTAL RESONATOR (RX)	983534-xxx
X203	CRYSTAL RESONATOR (RX)	983534-xxx
X204	CRYSTAL RESONATOR (RX)	983534-xxx
X205	CRYSTAL RESONATOR (RX)	983534-xxx
X206	CRYSTAL RESONATOR (RX)	983534-xxx
XS101	CRYSTAL SOCKET (S-20-6P)	983448-20
XS201	CRYSTAL SOCKET (S-20-6P)	983448-20

NOTE

When ordering crystals the desired channel number must be specified.

Chassis Mounted Components

C001	330 uF,16V,ELECTROLYTIC	
C002	1000 pF,±10%,50V,MYLAR	
C003	1000 pF,±20%,50V,CERAMIC	
D001	DIODE,SILICON (RA-1Z)	
D002	LED,RED (SR-103D)	
F001	3 AMP FUSE (F7142-3A)	
J001	RF JACK (HMB-R-3)	983448-6
J002	AF JACK (EJU-3E)	983448-7
J003	DC JACK (EC342-1-1)	983448-8
M001	METER (MC-12M)	983448-9
MIC	MICROPHONE (WM-034X)	983448-10
R001	560,±10%,1/2W,CARBON FILM	
R002	3.3,±10%,1/2W,SOLID	
S001	TOGGLE,SWITCH (MTE-106D-1	983448-11
S002	PTT SWITCH (AM6220)	983448-12
S003	ROTARY SWITCH (AM6220)	983448-13
SP001	SPEAKER (EAS6P75CM)	983448-14

	Part Number
NTROL(FA4D-8805)	983448-15
ONTROL	983448-16
	983448-1
LATOR PCB	983448-2
ENNA	983448-3
S	983448-4
	983448-5

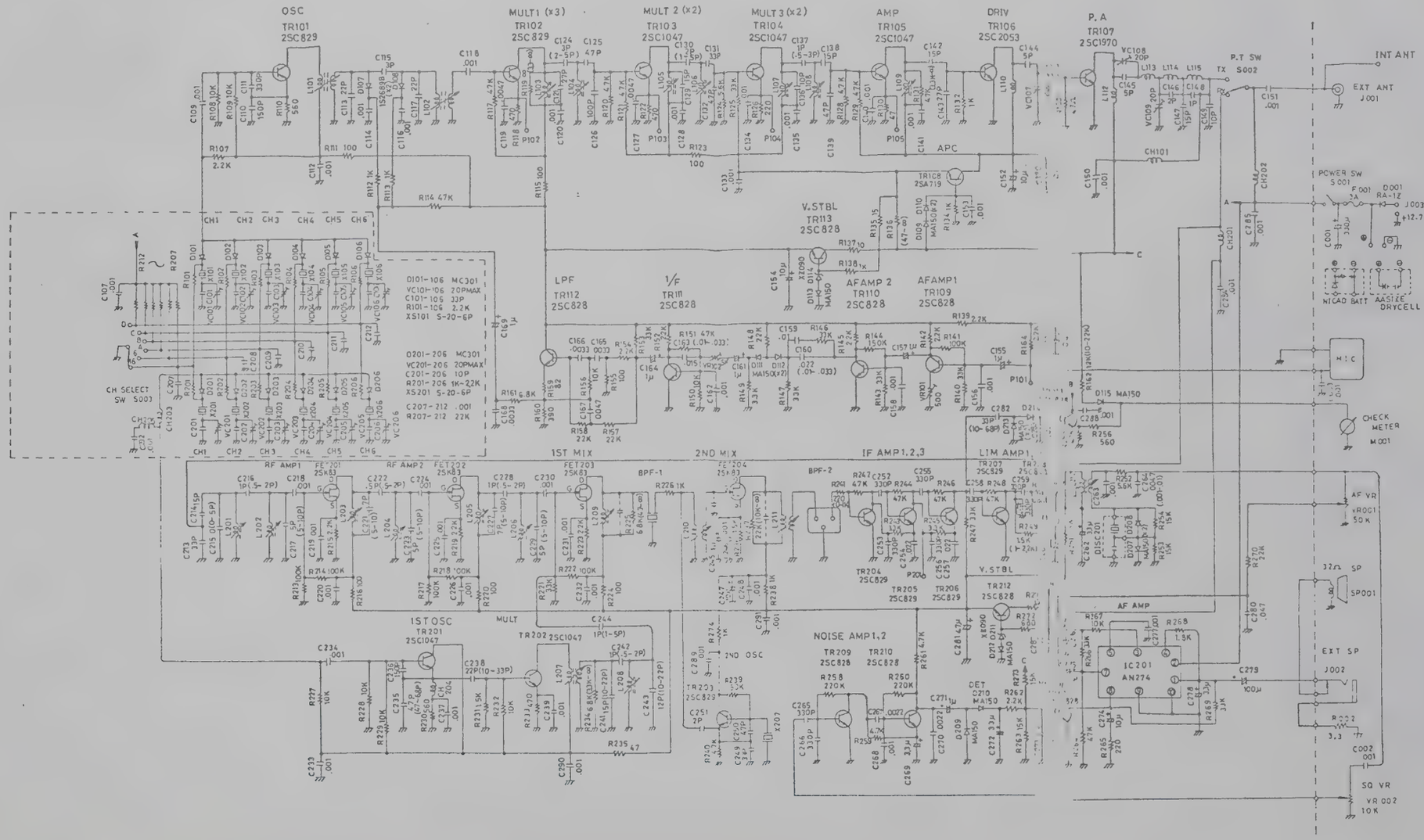
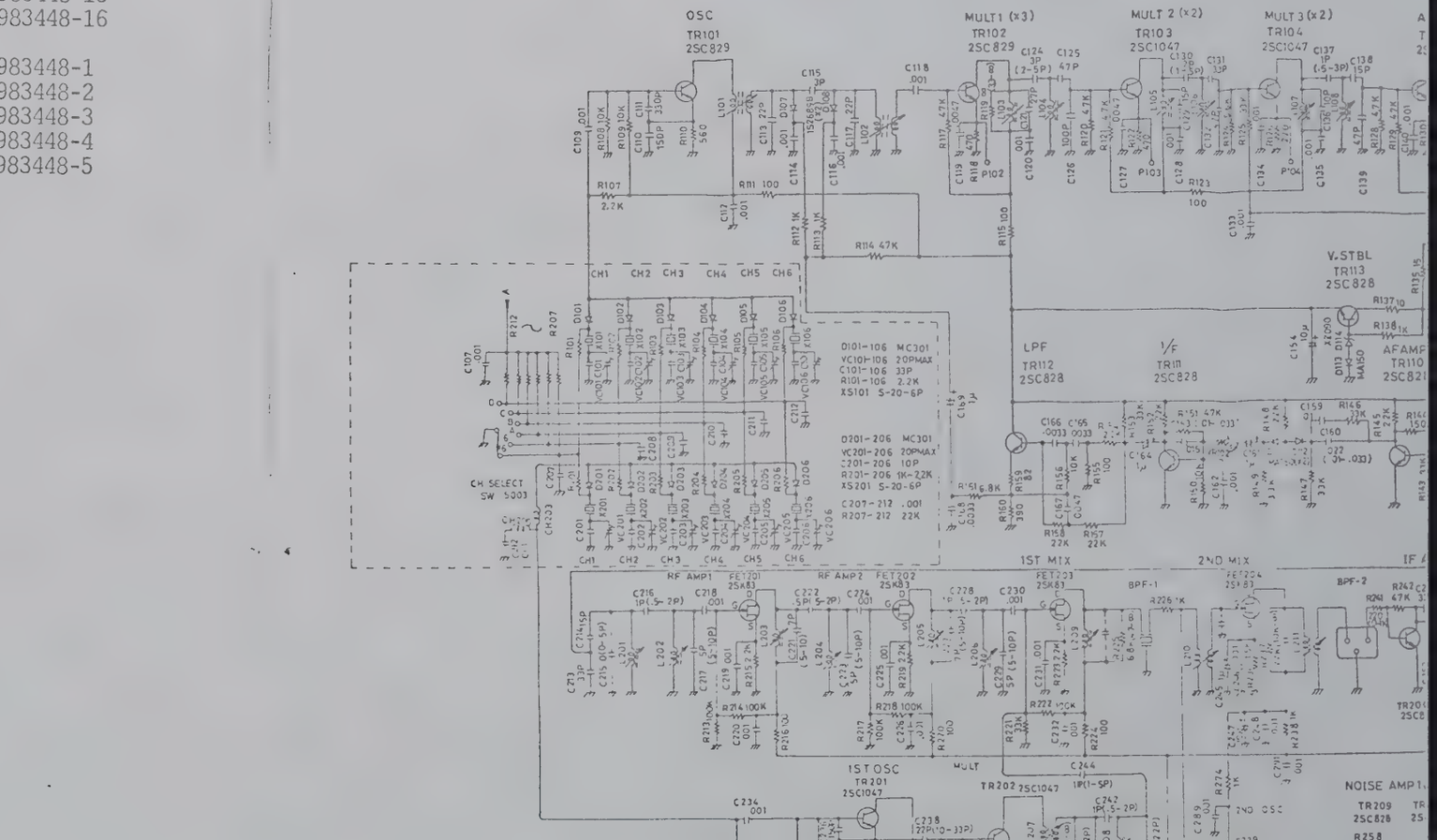


Figure 6-1 AF6 Schematic Diagram

Table 6-1 AF6 Parts List (11 of 11)

Reference Symbol	Description	Part Number
VR001	50k VOLUME CONTROL(FA4D-8805)	983448-15
VR002	10k SQUELCH CONTROL (FA4D-8801)	983448-16
	MAIN PCB	983448-1
	CRYSTAL OSCILLATOR PCB	983448-2
	INTERNAL ANTENNA	983448-3
	KNOB,CONTROLS	983448-4
	BATTERY PACK	983448-5



RAYTHEON

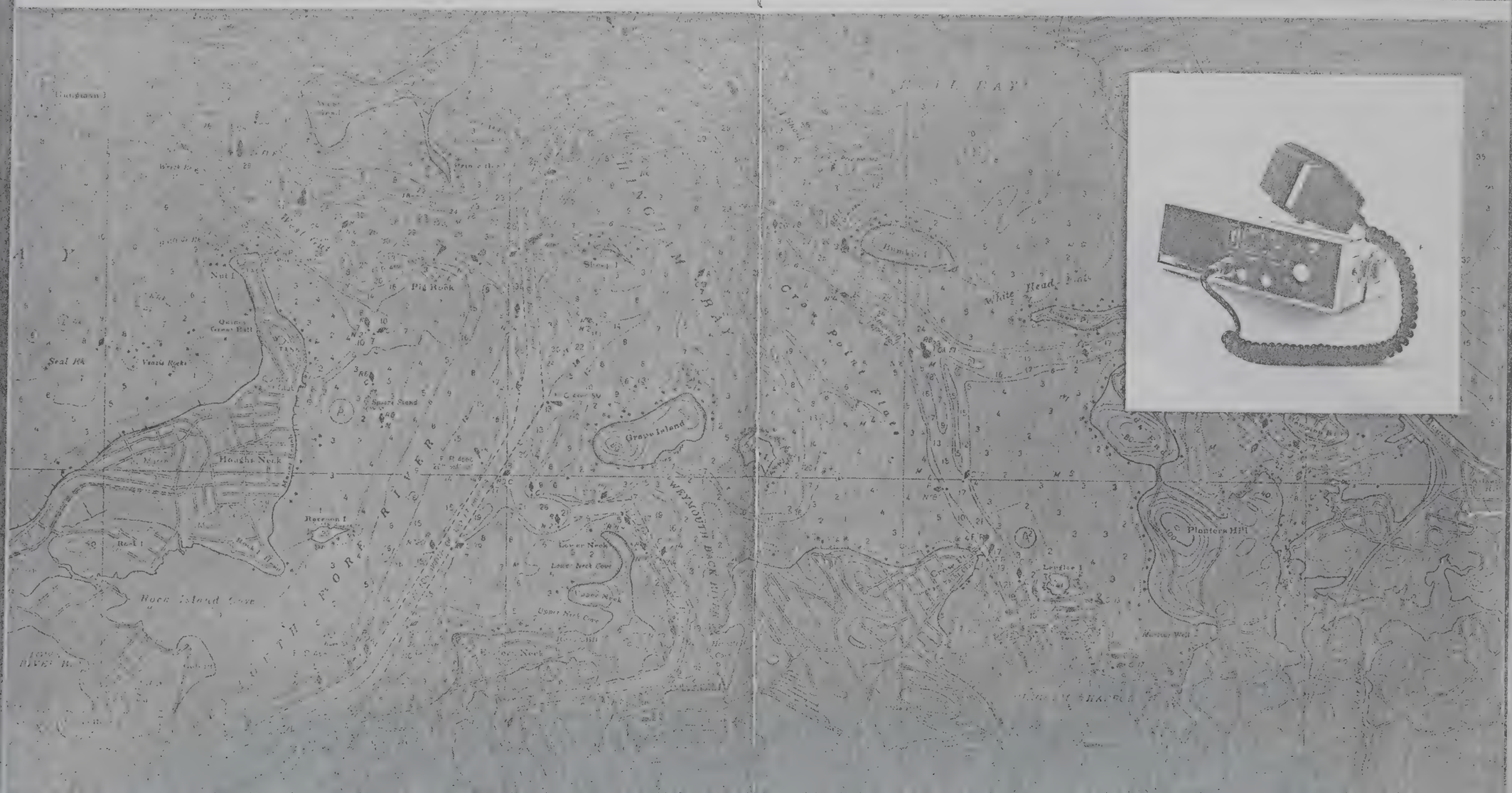
Raytheon Marine Company
676 Island Pond Road, Manchester, N.H. 03103
(603) 668-1600

168705 (11/77) PRINTED IN U.S.A.

RADIO DEL REY
701 Washington Street
Marina del Rey, CA 90291
821-6200

RAYTHEON

MODEL RAY-48A
VHF-FM
RADIOTELEPHONE
INSTRUCTION MANUAL



PURPOSE

THIS MANUAL CONTAINS IMPORTANT INFORMATION ON THE INSTALLATION, OPERATION AND MAINTENANCE OF YOUR EQUIPMENT.

RAYTHEON MARINE COMPANY products are supported by a worldwide network of Authorized Service Representatives.

The below-listed Raytheon Marine Company Factory Service Centers will either assist you directly, or refer you to an Authorized Service Representative.

FACTORY SERVICE CENTERS

CALIFORNIA:
633 N. Marine Avenue
Wilmington, Ca. 90744
(Los Angeles)
Phone: (213)835-0147

FLORIDA:
1107 N. Ward Street
Tampa, Fl. 33607
Phone: (813)877-9418

LOUISIANA:
525 Jefferson Street
New Orleans, La. 70121
Phone: (504)835-6491

MASSACHUSETTS:
Phone: (617)935-6710

NEW HAMPSHIRE:
25 Industrial Village
Londonderry, N.H. 03053
(Manchester)
Phone: (603)668-1600

NEW YORK:
756 5th Avenue
Brooklyn, N.Y. 11232
Phone: (212)768-2511

Rayscan-Copenhagen
Siljangade 6-8
DK-2300 Copenhagen S
Denmark
Phone: 451-550702

TEXAS:
1203 Galveston Street
South Houston, Tx. 77587
Phone: (713)941-2700

VIRGINIA:
6529 Tidewater Drive
Norfolk, Va. 23509
Phone: (804)857-0178

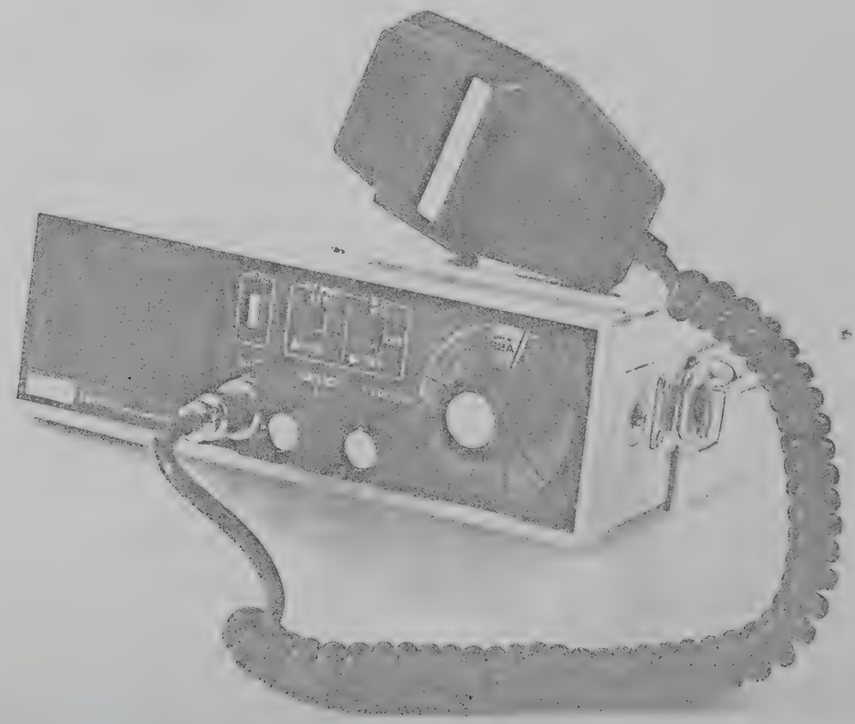
WASHINGTON:
4800 20th Ave. NW
Seattle, Wa. 98107
Phone: (206)782-0242

MODEL RAY-48A

VHF-FM RADIOTELEPHONE

INSTRUCTION MANUAL

RAYTHEON



RAYTHEON

Raytheon Marine

Limited Warranty

Marine Products

Raytheon Marine Company warrants all parts of each new product against defects in material and workmanship under normal use, and will repair or exchange any parts proven to be defective at no charge for a period of TWO YEARS from the date of original installation, EXCEPT AS PROVIDED BELOW.

Defects will be corrected by an authorized Raytheon Marine Company Service Station. There will be no charge for labor for a period of ONE YEAR from date of original installation, EXCEPT AS PROVIDED BELOW, and during this time Raytheon Marine Company will assume travel costs of its Authorized Service Station Representative up to a total of 100 highway miles.

WARRANTY LIMITATIONS

Raytheon Marine Company will not be responsible for equipment which has been subjected to accident, abuse, or misuse, nor any equipment on which the serial plate has been removed, altered, or mutilated.

Except where Raytheon Marine Company has performed the installation, it assumes no responsibility for damage incurred during installation.

This warranty is effective only with respect to the original purchaser from Raytheon Marine Company or an authorized Raytheon Marine Company Representative.

A validated warranty certificate and station logbook (if applicable) must be made available to the authorized Raytheon Marine Service Station Representative at the time of service.

On radar installations, the magnetron, T/R cell, klystron, and modulator tube (if applicable), and cathode ray tube are warranted for SIX MONTHS from date of original installation.

Chart paper, stylii, stylus belts, lamps, and fuses are consumable items, and are not covered by this warranty.

Any cost associated with transducer replacement, other than the cost of the transducer itself, is specifically excluded from this warranty.

Travel costs will not be accepted for products that do not require installation by an Authorized Service Station.

Raytheon Marine Company equipment or parts thereof which have been repaired or altered outside of its plant except by Authorized Raytheon Marine Company Service Stations are not warranted in any respect.

This warranty is STRICTLY LIMITED to the terms indicated herein, and no other express warranties or remedies thereunder shall be binding on Raytheon Marine Company. TO THE EXTENT CONSISTENT WITH STATE AND FEDERAL LAW: (1) ANY IMPLIED WARRANTIES SHALL BE LIMITED TO THE SAME TIME PERIODS STATED HEREIN FOR EXPRESS WARRANTIES, AND (2) RAYTHEON MARINE COMPANY SHALL NOT BE LIABLE FOR CONSEQUENTIAL DAMAGES UNDER ANY EXPRESS OR IMPLIED WARRANTIES RELATING TO THIS EQUIPMENT.

RAYTHEON MARINE COMPANY
676 Island Pond Road, Manchester, New Hampshire 03103

86-52 (4/77)

NOTE: THE SAMPLE WARRANTY STATEMENT IS FURNISHED FOR REFERENCE ONLY. PLEASE REFER TO THE WARRANTY CERTIFICATE ISSUED WITH YOUR EQUIPMENT FOR SPECIFIC TERMS AND CONDITIONS.

TABLE OF CONTENTS

		Page
SECTION 1	INTRODUCTION	
1.1	GENERAL	1-1
1.2	SPECIFICATIONS	1-1
	Transmitter	1-1
	Receiver	1-2
	Operating Voltage Requirement	1-3
	Input Current	1-3
	Dimensions	1-3
SECTION 2	OPERATION	
2.1	CONTROLS, INDICATORS, AND CONNECTORS	2-1
2.2	OPERATING PROCEDURE	2-2
2.2.1	To Receive	2-2
2.2.2	To Transmit	2-3
SECTION 3	RADIOTELEPHONE SERVICES	
3.1	BASIC RADIOTELEPHONE SERVICE	3-1
3.2	GETTING ON THE AIR	3-1
3.3	TECHNICAL REQUIREMENTS	3-1
3.4	REGISTER WITH THE COAST STATION	3-2
3.5	MARINE RADIOTELEPHONE	3-2
3.5.1	VHF Service	3-3
3.6	DISTRESS, URGENCY AND SAFETY MESSAGES	3-6
3.6.1	Distress Signal: MAYDAY	3-7
3.6.2	Urgency Signal: PAN	3-8
3.6.3	Safety Signal: SECURITY	3-8
3.7	WEATHER BROADCASTS	3-8
3.8	KEEPING THE LOG	3-8

3.9 PHONETIC ALPHABET 3-9

RULES TO REMEMBER 3-10

SECTION 4 LICENSING

4.1 GENERAL 4-1

4.2 SHIP STATION LICENSE 4-1

4.3 RENEWAL OF SHIP STATION LICENSE 4-1

4.4 INTERIM SHIP STATION LICENSE FOR RADIOTELEPHONE 4-1

4.5 OPERATOR LICENSE 4-2

4.6 APPLICATION FOR OPERATOR PERMIT 4-2

4.7 FEES 4-3

SECTION 5 INSTALLATION

5.1 GENERAL CONSIDERATIONS 5-1

5.2 CONNECTING 12V POWER SOURCE 5-1

5.3 GROUNDING 5-1

5.4 SELECTING AND INSTALLING THE ANTENNA 5-3

5.5 INSTALLING ADDITIONAL CHANNELS 5-5

5.6 MOUNTING MICROPHONE AND EXTERNAL SPEAKER 5-5

SECTION 6 THEORY OF OPERATION

6.1 RECEIVER 6-1

6.2 TRANSMITTER 6-2

SECTION 7 MAINTENANCE

7.1 GENERAL 7-1

7.2 BASIC MAINTENANCE PROGRAM 7-1

7.3 INSTALLING ADDITIONAL OR NEW CHANNELS 7-2

7.4 FREQUENCY ADJUSTMENT 7-7

7.5 PRELIMINARY ALIGNMENT AND CHECKOUT 7-8

7.5.1 Receiver 7-8
7.5.2 Transmitter 7-8

7.6 TRANSMITTER ALIGNMENT 7-9

7.6.1 Oscillator and Buffer 7-10
7.6.2 Transmitter Multiplier 7-10
7.6.3 RF Power Amplifier 7-10
7.6.4 Low Power Output Adjustment 7-11
7.6.5 Modulator Deviation 7-11
7.6.6 18.5 kHz Filter (L621) 7-12

7.7 RECEIVER ALIGNMENT 7-12

7.7.1 Local Oscillator 7-12
7.7.2 RF Amplifier 7-13
7.7.3 IF Amplifier 7-14

7.8 TROUBLESHOOTING 7-15

7.8.1 Receiver Operational Checks 7-15
7.8.2 Transmitter Operational Checks 7-15
7.8.3 Receiver DC Voltages 7-16
7.8.4 Transmitter DC Voltages 7-17

SECTION 8 SCHEMATIC DIAGRAM AND PARTS LIST 8-1

SECTION 9 MARINE MOBILE ANTENNAS

9.1 GENERAL 9-1

9.2 ANTENNA MOUNT MODEL AM18 9-2

9.3 ANTENNA MOUNT MODEL AM-1W 9-2

9.4 ANTENNA MOUNTING/INSTALLATION 9-2

LIST OF ILLUSTRATIONS

Figure No.	Title	Page
1-1	Controls, Indicators and Connectors	2-2
5-1	RAY-48A Outline and Mounting Dimension	5-2
5-2	Installation of the RAY-48A	5-3
5-3	Typical Antenna Locations on Various Types of Craft	5-4
6-1	RAY-48A System Block Diagram	6-3
7-1	Output Power Vs Supply Voltage	7-9
8-1	RAY-48A VHF FM Marine Radiotelephone Schematic Diagram	8-2
9-1	Antennas and Mount Illustration	9-3

LIST OF TABLES

Table No.	Title	Page
2-1	Controls, Indicators and Connectors	2-1
3-1	VHF FM Marine Radiotelephone Channels and Functions	3-3 3-4
7-1	Recommended Commercial and Non-commercial Channels for the RAY-48A	7-5
7-2	Crystal Frequencies Required for Essential Channels	7-6
7-3	Crystal Trimmer Capacitors for Each Position of Channel Selector Switch	7-7
7-4	Receiver DC Voltage Chart	7-17
7-5	Transmitter DC Voltage Chart	7-18

SECTION 1

INTRODUCTION

1.1 GENERAL

Your RAY-48A VHF-FM radiotelephone has been designed for years of reliable, attention-free operation whether put to use under a recreational or commercial environment. Among the outstanding features contributing to its reliability and high performance are:

- All solid state circuitry, ensuring low power drain, minimal heat from unit, and maximum reliability
- High selectivity designed into receiver guarantees optimum performance under congested harbor conditions
- Twelve transmit/receive channels available - six set up for use in unit as delivered
- Two weather channels provided for the Environmental Science Services Administration (ESSA) continuous area forecasts and local reports. One channel is installed in unit delivered
- 3 watts audio power ensures ample volume to override wheelhouse noises
- Channels 6, 16, 22A, 28 and 68 provided in all units
- Mounting bracket supplied allows RAY-48A to be installed in any convenient location

1.2 SPECIFICATIONS

Transmitter

Channels	Twelve
Frequency range	156.275 to 157.425 MHz

Frequency stability	0.001% (-20°C to +50°C) (ship station)
Crystal type	HC 25/U (fundamental mode), in oven
Power output	25 watts into 50 ohm load, reducible to 1 watt
Modulation	Frequency-modulated (16F3) through modified phase modulator (±5 kHz deviation for 100% modulation)
Modulation limiting	Instantaneous, automatic at 100% modulation
Audio response	6 dB (+1 dB, -3dB) pre-emphasis 300 to 3000 Hz
Audio roll-off filter	Exceeds FCC requirements of 18 dB per octave beyond 3000 Hz
Spurious outputs	At least 60 dB below rated carrier output
Hum and noise level	At least 40 dB below two-thirds of full modulation

Receiver

Channels	Fourteen
Frequency range	156.275 to 162.55 MHz
Frequency stability	0.001% (-20°C to +50°C)
IF frequency	16.9 MHz 1st IF and 455 kHz 2nd IF
Sensitivity	
20 dB quieting	0.5 uV
12 dB Sinad	0.35 uV
Modulation acceptance	6.5 kHZ
Squelch sensitivity	Not more than 0.5 uV

Audio output	3 watts or more at 10% or less distortion into an external 4 ohm load, or 1.5 watts into an internal speaker
Adjacent channel selectivity and desensitization	At least 60 dB
Spurious response	Greater than 70 dB

Operating Voltage Requirement

Input voltage	13.6 volts DC (nominal)
Operating range	11.6 to 15.6 volts DC

Input Current

Receive mode (no signal)	Less than 400 mA
Transmit	5.5 A
Crystal oven	250 mA average at 25°C

Dimensions

Height	2.7 in.	68 mm
Width	8.0 in.	202 mm
Depth	11.1 in.	283 mm
Weight	6.5 lb.	3.0 kg

SECTION 2

OPERATION

2.1 CONTROLS, INDICATORS, AND CONNECTORS

Figure 2-1 and Table 2-1 illustrate and describe the functions of each control, indicator or connector essential to the operation of the RAY-48A.

Table 2-1 Controls, Indicators and Connectors (see Figure 2-1)

Location	Control	Function
1	SQUELCH	Adjusts threshold at which squelch becomes operative.
2	Pilot (indicator)	Indicates power is on. Illuminates the channel selector.
3	WX W1/OFF/W2	Selects weather channel (receive only). In OFF position operation is restored to normal channels for two-way communication.
4	RF PWR 25W - 1W	Selects transmit power level. High power 25 watts; low power 1 watt.
5	MIC (connector)	Accepts connector supplied with RAY-48A microphone.
6	TX (indicator)	Illuminates to indicate when unit is transmitting.
7	Channel selector	Permits two-way communication on selected channel whenever WX switch is set to OFF.
8	VOLUME OFF	Turns power on and off. Adjusts speaker volume whenever SQUELCH threshold is set below noise or signal level.

Table 2-1 Controls, Indicator and Connectors (Con't.)

Location	Control	Function
9	Antenna	Female coaxial connector Type S0-239 cable (mates with a PL259).
10	Power connector (unmarked)	A male plug that accepts connector of power cable furnished with the RAY-48A.
11	Jack (unmarked)	Accepts a plug for connection of an external 4 ohm to 8 ohm speaker.

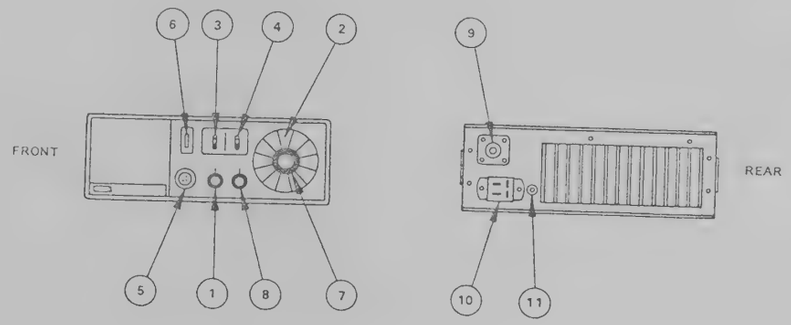


Figure 1-1 Controls, Indicators and Connectors

2.2 OPERATING PROCEDURE

2.2.1 To Receive:

1. Rotate VOLUME control clockwise and adjust for a comfortable listening level.

2. Set channel selector to desired operating channel and readjust the VOLUME control as necessary.

3. Adjust SQUELCH control clockwise slowly until background noise is just muted. This should be done when there are no signals being received. It is important that this control be adjusted just to the threshold point, so that a weak signal will still be audible. When a transmission is made, it will trip the squelch circuit, allowing signal to be heard.

4. Weather reports are continuously available on either W1 or W2 position of the WX control. Either position overrides all other receive channels, so it is necessary to return the WX selector to the OFF position to again receive or transmit normal communications.

2.2.2 To Transmit:

1. Select desired channel and listen carefully to assure that it is not busy. If it is busy you will hear voices or an intermittent busy tone. Do not interrupt unless an emergency situation exists.

2. If the channel is clear, press the PUSH-TO-TALK button on the microphone to activate the transmitter. Announce the name of the boat you are calling and its call letters (if available), followed by the name of your boat and your call letters. Repeat if necessary. Release the microphone button to receive a reply. At the end of the conversation announce that you are signing off and again give the name and call sign of your boat.

Your transmitter is in operation only when the microphone button is depressed, and only then can others hear you. The receiver functions only when the button is released, and only then can you hear others.

SECTION 3

RADIOTELEPHONE SERVICES

3.1 BASIC RADIOTELEPHONE SERVICE

Radiotelephone communication capability provides important benefits of safety and convenience. It is possible to call, or be called by, the Coast Guard or other vessels within range.

3.2 GETTING ON THE AIR

Before a vessel can lawfully transmit any message, with or without the assistance of a Marine Telephone Operator, the FCC requires that the following be on board:

1. A valid ship's radiotelephone station license
2. A licensed radiotelephone operator
3. A radiotelephone station log book

Federal Communications Commission regulations prohibit the use of profane language, and establish other reasonable controls. All persons aboard a vessel who will be using its communications equipment should be familiar with these and with approved operating procedures. Frequencies are shared with other boatmen. Contact should be kept brief so that all may have an equal opportunity to transmit and receive messages.

3.3 TECHNICAL REQUIREMENTS

The Telephone Company (or independent common carrier) operates the shore-base radio stations. It does not rent, lease or sell radiotelephone equipment for use aboard ship. Such equipment is owned and maintained by the boat owner or, in some cases, by a maritime radio operating company. The selection, installation, and maintenance of a shipboard radio station is highly technical and should be entrusted only to a licensed, reliable marine radio service concern.

The owner's service requirements and the operating area will determine the type of marine telephone service and the specific installation needed. Transmitters must meet the requirements set forth in the International Regulations applicable in the country in which the ship is registered. Vessels of United States registry must conform to the regulations of the FCC.

3.4 REGISTER WITH THE COAST STATION

If regular use of Public Marine Radiotelephone Service is planned, it is important to register with the owner of the coast station serving the primary area of operation. Registration with Bell System stations is free. It provides the coast station with billing information for calls, and saves the air time necessary to transmit this information on each call.

For information on Bell System Marine services, or to register a vessel, call the Telephone Company representative in your area.

Atlanta, GA	404-877-3895	Milwaukee, WI	414-350-8870
Baltimore, MD	301-393-1036	Montreal, Canada	514-870-7189
Birmingham, AL	205-321-8509	Newark, NJ	201-649-2014
Boston, MA	617-743-4035	New Orleans, LA	504-581-7337
Charleston, SC	803-722-9011	New York, NY	212-564-0410
Charlotte, NC	704-372-9456		212-393-7394
Chicago, IL	312-727-1574	Norfolk, VA	804-424-9911
Cincinnati, OH	513-397-3431	Omaha, NB	402-422-8656
Cleveland, OH	216-822-4840	Philadelphia, PA	215-466-4648
Detroit, MI	313-354-9550	Portland, OR	503-224-6261
Houston, TX	713-521-6355	San Francisco,CA	415-986-5216
	713-521-7708		415-442-2262
Indianapolis, IN	317-630-1697	Seattle, WA	206-345-2341
Jacksonville, FL	904-353-2315	Washington, DC	202-392-3682
Los Angeles, CA	213-744-1616		202-637-9900
Miami, FL	305-379-0745	Wilmington, NC	919-763-4675
	305-350-8026		

NOTE

Keep the Telephone Company informed of any changes that affect your registration.

3.5 MARINE RADIOTELEPHONE

The Bell System and numerous independent commom carriers maintain a network of marine radio stations strategically located along the coastal waters and major inland waterways of the 48 contiguous states of the U.S. Stations are generally operated around the clock.

3.5.1 VHF Service

1. Public Class III-B Coast Stations

This service offers reliable operation with good transmission quality over distances of 20 to 50 miles, using FM with channels in the 156 MHz to 162 MHz range. Antenna height and equipment quality are the primary factors that determine communication range.

2. VHF Channels

There are 29 noncommercial VHF channels available in the United States. They are grouped into categories for specific uses so that maximum utilization with minimum interference can be attained. A listing by category may be found in Table 3-1.

Channels for use only by commercial vessels are: 7, 8, 10, 11, 18, 19, 67, 77, 79, 80, and 88. Channels for International use only are: 1, 2, 3, 4, 5, and 78.

Table 3-1 VHF FM Marine Radiotelephone Channels and Functions (1 of 2)

CHANNEL DESIG	FREQUENCY (MHz) SHIP	SHORE	TYPE OF TRAFFIC	FUNCTION SHIP TO SHIP	SHIP TO SHORE
6	156.300		Safety	Yes	No
7	156.350	160.950	Commercial	No	Yes
7A	156.350	156.350	Commercial	Yes	Yes
8	156.400		Commercial	Yes	No
9	156.450	156.450	Port Operation	Yes	Yes
10	156.500	156.500	Commercial	Yes	Yes
11	156.550	156.550	Commercial	Yes	Yes
12	156.600	156.600	Port Operation	Yes	Yes
13	156.650	156.650	Navigational	Yes	Yes
14	156.700	156.700	Port Operation	Yes	Yes
15	156.750	156.750	Weather Pending	Receive Only	Receive Only
16	156.800	156.800	Safety and Calling	Yes	Yes
17	156.850	156.850	State Control	No	Yes
18	156.900	161.500	Int'l Only	No	Yes
18A	156.900	156.900	Commercial	Yes	Yes
19	156.950	161.550	Int'l Only	No	Yes
19A	156.950	156.950	Commercial	Yes	Yes
20	157.000	161.600	Port Operation	No	Yes
21	157.050	161.650	Port Operation	No	Yes
21A	157.050	156.050	Special Public Correspondence	No	Yes
21CG	157.050	157.050	Coast Guard	Yes	Yes
22	157.100	161.700	Port Operation	No	Yes
22A	157.100		Port Operation	Yes	Yes
22CG	157.100	167.100	Coast Guard	Yes	Yes
23	157.150	161.750	Public Correspondence	No	Yes

Table 3-1 VHF FM Marine Radiotelephone Channels and Functions (2 of 2)

CHANNEL DESIG	FREQUENCY (MHz) SHIP	SHORE	TYPE OF TRAFFIC	FUNCTION SHIP TO SHIP	SHIP TO SHORE
23A	157.150	156.150	Special Public Correspondence	No	
23CG	157.150	157.150	Coast Guard	Yes	Yes
24	157.200	161.800	Public Correspondence	No	Yes
25	157.250	161.850	Public Correspondence	No	Yes
26	157.300	161.900	Public Correspondence	No	Yes
27	157.350	161.950	Public Correspondence	No	Yes
28	157.400	162.000	Public Correspondence	No	Yes
65	156.275	160.875	Int'l Only	No	Yes
65A	156.275	156.275	Port Operation	Yes	Yes
66	156.325	160.925	Int'l Only	No	Yes
66A	156.325	156.325	Port Operation	Yes	Yes
67	156.375		Commercial	Yes	No
68	156.425	156.425	Non Commercial	Yes	Yes
69	156.475	156.475	Non Commercial	No	Yes
70	156.525		Non Commercial	Yes	No
71	156.575	156.575	Non Commercial (Marinas)	No	Yes
72	156.625		Non Commercial	Yes	No
73	156.675	156.675	Port Operation	Yes	Yes
74	156.725	156.725	Port Operation	Yes	Yes
77	156.875		Commercial'	Yes	No
78	156.925	161.525	Int'l Only	No	Yes
78A	156.925	156.925	Non Commercial	No	Yes
79	156.975	161.575	Int'l Only	No	Yes
79A	156.975	156.975	Commercial	Yes	Yes
80	157.025	161.625	Int'l Only	No	Yes
80A	157.025	157.025	Commercial	Yes	Yes
81	157.075	161.675	Port Operation	No	Yes
81A	157.075		Port Operation	Yes	Yes
82	157.125	161.725	Port Operation Public Correspondence	No	Yes
82A	157.125		Port Operation	Yes	Yes
83	157.175	161.775	Public Correspondence	No	Yes
83A	157.175	156.175	Special Public Correspondence	No	Yes
83CG	157.175	157.175	Coast Guard Aux	Yes	Yes
84	157.225	161.825	Public Correspondence	No	Yes
85	157.275	161.875	Public Correspondence	No	Yes
86	157.325	161.925	Public Correspondence	No	Yes
87	157.375	161.975	Public Correspondence	No	Yes
88	157.425	162.025	Int'l Only	No	Yes
88A	157.425		Commercial	Yes	No
WE1		162.550	ESSA Weather	Receive Only	Receive Only
WE2		162.400	ESSA Weather	Receive Only	Receive Only
WE3		162.475	ESSA Weather	Receive Only	Receive Only

3. Placing Calls on VHF/Ship-to-Shore

   a. Listen to verify channel to desired stations is not busy.
   b. When channel is clear, put transmitter on air for 15 to 20 seconds - repeat until channel is clear or Operator answers.
   c. When the Marine Operator answers, say: "This is (Ship Call Signal) the telephone billing number is. . .". If there is no telephone billing number, state caller's name, ship's name and address in city of registry.
   d. Finish up with the city and telephone number being called. Proceed thereafter as directed.
   e. At the end of the conversation, repeat ship's name and call sign and sign off with "clear" or "out".

4. Placing Shore-to-Ship Calls

   a. Call the local telephone operator and ask for the Marine Operator.
   b. Give the Marine Operator the name of the ship being called, its call sign, location, and selective signaling code number (if applicable). Proceed thereafter as directed.

5. Receiving Shore-to-Ship Calls

   To receive public coast station calls, a receiver must be in operation on the proper channel.

   When calling on VHF, Bell System coast stations will generally call on their assigned channel frequency.

   On Coastal Harbor frequencies, Bell System coast stations normally call on a working channel of the coast station, but will call on the distress frequency (156.8 MHz) when requested to do so by the calling party.

Since it is mandatory for commercial operators to maintain a watch on Channel 16 (156.8 MHz), many commercial operators carry an additional receiver tuned to a working frequency of their area coast station. This enables them to receive a high percentage of calls on the first attempt.

When you hear your boat called, answer as follows: (Name of coast station that called) "This is (Name of your vessel and call sign), Over". Proceed thereafter as directed.

6. Ship-to-Ship Direct

To directly contact another vessel, compatible equipment must be available. If the other vessel is out of range, make contact through the Marine Operator.

Most direct ship-to-ship contacts are originated on the distress calling and safety frequency - Channel 16 (156.8 MHz).

a. On Channel 16, give the name of the vessel being called, and the name and call sign of the calling vessel.
b. When the called vessel answers, it should suggest an intership frequency on which to complete the conversation. Calls must be limited to 3 minutes except in emergencies.
c. When the call is complete, sign off with vessel name and call sign. You may not call the same boat again for at least 10 minutes.
d. Return your receiver to distress safety and calling, Channel 16.

3.6 DISTRESS, URGENCY AND SAFETY MESSAGES

If the radiotelephone is turned on, and not in use, it should be monitoring the calling and safety frequency (Channel 16). This channel is monitored 24 hours a day by the Coast Guard and most commercial shore stations. If help is needed, it can be on its way in moments from the Coast Guard and other vessels in the area.

Distress, urgency and safety messages are identifiable by a code word at the beginning of each message. This word indicates the priority of the message.

3.6.1 Distress Signal: MAYDAY

Used if there is an immediate danger of loss of life or property. MAYDAY has priority over all other communications.

1. If a MAYDAY is Heard

Immediately discontinue any transmission. Note the details of the message in the radio log immediately. A call to relay information or render assistance may be received. Having the facts may make it possible to help save a vessel or a life.

Unless you are in a position to render assistance, do not make any transmissions on this channel until the MAYDAY condition is lifted by the Coast Guard.

2. To Make a MAYDAY Call

a. Switch to Channel 16 (156.8 MHz)

> *NOTE*
>
> *Because the primary purpose of the channel is to summon help, it is likely that an immediate response will be received. If not, repeat the message. If still no reply, transmit on any other available frequency until contact is made.*

b. Speaking slowly and distinctly, say "MAYDAY, MAYDAY, MAYDAY. This is . . ." giving the name of your vessel and call sign three times. Then continue with the distress message, as follows, still speaking slowly and distinctly.
c. Name of the calling vessel.
d. Position (or best estimate).
e. Assistance needed.
f. Description of vessel (type, color, length, number of persons aboard, etc.).
g. Indicate end of message by saying, "Over".

3.6.2 Urgency Signal: PAN

Used when the safety of a vessel or person is in jeopardy. "Man overboard" messages are sent with this urgency signal. PAN has priority over all other communications with the exception of distress traffic.

3.6.3 Safety Signal: SECURITY

Used for messages concerning the safety of navigation and transmission of important meteorological warnings.

3.7 WEATHER BROADCASTS

Coast Guard stations transmit weather information in many areas. Local frequencies and schedules may be obtained from the nearest Environmental Science Services Administration (ESSA) office. The U.S. Weather Bureau broadcasts current weather on channels W1 (162.55 MHz), W2 (162.400 MHz), and W3 (162.475 MHz). Channel W4 (161.650) is the Canadian weather broadcast frequency.

At some shore stations, the Marine Operator broadcasts weather information. The Marine Operator may be consulted for channels used and time schedule of broadcasts. Commercial broadcasting stations generally broadcast weather reports and forecasts as part of their news coverage.

> *NOTE*
>
> *No prudent boatman ventures out of port without the best available knowledge of weather conditions and possible changes. Your radiotelephone can help you obtain this important information.*

3.8 KEEPING THE LOG

> *NOTE*
>
> *Radiotelephone logs must be retained for at least one year, and for three years if they contain entries concerning marine disaster or distress. This period may be longer if an investigation is underway or pending.*

The FCC requires the following entries in a radiotelephone log each day underway:

1. Name of vessel.
2. Vessel's call sign.
3. Operator's signature.
4. Date and listening time on Channel 16 (156.8 MHz) using the 24 hour clock.
5. All distress (MAYDAY) messages heard or transmitted.
6. All urgency (PAN) and safety (SECURITY) messages transmitted.
7. Distress, urgency, and safety messages should be logged in as much detail as possible, including date, time of day, operating frequencies, vessel's name and position, and nature of emergency.
8. All installation, service, and maintenance details that affect the operation of the transmitter must be entered by the licensed technician performing such work, including his address and the class, serial number and expiration date of his license.

3.9 PHONETIC ALPHABET

To help make call letters more clearly understood, and to assist in spelling out similar-sounding or unfamiliar words, radiotelephone users usually employ the international phonetic alphabet, as shown below.

PHONETIC ALPHABET

A - ALPHA	J - JULIET	S - SIERRA
B - BRAVO	K - KILO	T - TANGO
C - CHARLIE	L - LIMA	U - UNIFORM
D - DELTA	M - MIKE	V - VICTOR
E - ECHO	N - NOVEMBER	W - WHISKEY
F - FOXTROT	O - OSCAR	X - X-RAY
G - GOLF	P - PAPA	Y - YANKEE
H - HOTEL	Q - QUEBEC	Z - ZULU
I - INDIA	R - ROMEO	

RULES TO REMEMBER

YOUR RADIO CAN MEAN YOUR SAFE ARRIVAL - USE IT WITH RESPECT.

The following are some important points of proper usage recommended by the Radio Technical Commission for Marine Services, Washington, D.C. Numbers in parentheses refer to paragraphs in FCC Rules, Part 83.

BE SURE TO GIVE NAME AND POSITION OF VESSEL.

Emergency Situations

Distress	MAYDAY-MAYDAY-MAYDAY
Urgency message concerning safety of vessel or person(s)	PAN-PAN-PAN
Safety of navigation or important weather information	SECURITY-SECURITY-SECURITY

1. Maintain Your Watch	Listen to channel 16 when not in communication with another vessel (83.223)
2. Listen Before You Talk	Avoid interference with calls in progress (83.181).
3. Identify Your Vessel	Give your call sign and vessel name at beginning and end of each communication (83.364).
4. Make Calls Correctly	Call other vessels on channel 16 then switch to intership channel (83.366). Call public shore stations, in general, on an appropriate working channel (83.366).
5. Use Channels Properly	Channel 16 for emergencies and brief calls and replies (83.353). Intership (channel 6) for safety, operational or business communications (83.358).
6. Watch Your Language	Use of profane or obscene language is a criminal offense.

RULES TO REMEMBER (Cont'd)

7. Be Brief At All Times	Limit calls to 30 seconds; Conversations to 3 minutes (83.366).
8. Keep An Accurate Log	Make entries as required by (83.366).
9. Have Documents Handy	Ship Station License; Operator License or permit; Part 83 of FCC Rules; Log Book (83.3670).

If both VHF and MF (single sideband) radiotelephones are installed, VHF must be used whenever within VHF range. This is required by FCC regulations.

If you hear a MAYDAY call, respond only if in a position to render assistance or relay the distress message.

False distress signals are prohibited. Violation, under FCC regulations, may result in a maximum fine of $10,000 and imprisonment up to two years.

Keep your radiotelephone equipment in good working order. Have it checked periodically by a qualified, licensed technician.

Radiotelephone messages, like telephone conversations, are private. It is unlawful to make use of any information not intended for you.

SECTION 4

LICENSING

4.1 GENERAL

All radio stations aboard U.S. flag vessels must be licensed by the FCC under Part 83 of the FCC regulations. The licensee is responsible at all times for the lawful and proper operation of his station. Licenses are not granted to aliens except where the radio installation is required by law or treaty. Ship stations are licensed primarily for safety of life and property. Distress and safety communications must, therefore, have absolute priority.

4.2 SHIP STATION LICENSE

Application for a ship radiotelephone and/or radionavigation station (radar) license is made on FCC Form 502, except that FCC Form 501 shall be used for radiotelephone stations required by Title III, Part II of the Communications Act of 1934, as amended, or the Safety of Life at Sea Convention, or where the applicant is also the licensee of radiotelegraph equipment aboard the vessel. FCC Form 501 is used for charter boats and commercial vessels which require a radiotelephone installation.

4.3 RENEWAL OF SHIP STATION LICENSE

An application for renewal of a ship radiotelephone and/or ship radionavigation (radar) station license shall be filed on FCC Form 405-B, except that FCC Form 405-A shall be filed for renewal of a ship station license which also authorizes radiotelegraph equipment. Insofar as possible, FCC Form 405-B is mailed to the station licensee 60 days prior to expiration of his license. If it has not been received 30 days prior to expiration, FCC Form 405-B may be obtained upon request from the nearest FCC office. The application for renewal must be received by the FCC prior to the expiration date.

4.4 INTERIM SHIP STATION LICENSE FOR RADIOTELEPHONE

An interim license authorizing the operation of a ship radio station for a six-month period may be obtained at any Commission field engineering office upon presentation (by the applicant or any person who informs the office that he has been authorized to act in behalf of the applicant in securing an interim ship station license) of a properly completed application and an informal request for an interim license.

In Alaska only, an interim ship station license may be obtained by mailing a properly completed application and a written request for an interim ship station license to the Commission's field engineering office at Anchorage.

The full-term license will be mailed to the licensee prior to the expiration of the interim license.

The interim license procedure does not apply to renewal applications.

4.5 OPERATOR LICENSE

The radiotelephone transmitter in a ship station may be operated only by a licensed radio operator. The licensed operator may permit others to operate the transmitter if he starts, supervises, and ends the operation, makes the necessary log entries, and transmits the necessary identification. The license usually held by the radio operators aboard small vessels not required to carry a radio installation for safety purposes is the Restricted Radiotelephone Operator Permit or verification card of a third class or higher radiotelegraph or radiotelephone license. The Restricted Radiotelephone Operator Permit or verification card of a higher class license must be posted or kept on the operator's person (Rule 83.165). For vessels requiring a radiotelephone installation, the operator must have a third class radiotelephone operator permit.

4.6 APPLICATION FOR OPERATOR PERMIT

Field offices will accept applications filed on FCC Form 753 for the Restricted Radiotelephone Operator Permit if the applicant makes a satisfactory showing of immediate need for a permit for safety, and if the application is presented in person by the applicant or his agent. However, this lifetime permit is usually obtained by mailing an FCC Form 753 to the FCC at Gettysburg, Pennsylvania 17325. No oral or written examination is required.

Mailing addresses for Commission field offices are listed below. Street addresses can be found in local directories under "United States Government". Address all communications to "Engineer in Charge".

Alabama 36602, Mobile

Alaska 99501
P.O. Box 644, Anchorage

California 90012, Los Angeles

California 92101, San Diego

California 94111, San Francisco

California 90731, San Pedro

Colorado 80202, Denver

District of Columbia
20554, Washington

Florida 33130
P.O. Box 150, Miami

Florida 33602, Tampa

Georgia 30303, Atlanta

Georgia 31402,
P.O. Box 8004, Savannah

Hawaii 96808, Honolulu

Illinois 60604, Chicago

Louisiana 70130, New Orleans

Maryland 21202, Room 819
Federal Building, Baltimore

Massachusetts 02109, Boston

Michigan 48226, Detroit

Minnesota 55101, St. Paul

Missouri 64106, Kansas City

New York 14203, Buffalo

New York 10014, New York

Oregon 97204, Portland

Pennsylvania 19106, Philadelphia

Puerto Rico 00903, San Juan

Texas 77701
P.O. Box 1527, Beaumont

Texas 75202, Dallas

Texas 77002, Houston

Virginia 23510, Norfolk

Washington 98104, Seattle

4.7 FEES

Applications for any license must be accompanied by the appropriate fee, if any. The nearest FCC office should be consulted for information regarding application or filing fees.

SECTION 5

INSTALLATION

5.1 GENERAL CONSIDERATIONS

The RAY-48A may be installed in any convenient location; however, it must not be exposed to salt spray. The mounting bracket permits both horizontal and vertical mounting (to the overhead, on a shelf, or to a bulkhead, for example). Outline diagram Figure 5-1 shows dimensions to drill holes for the mounting bracket.

5.2 CONNECTING 12V POWER SOURCE

Refer to specifications in Section 1 for supply voltage and current requirements. As shown in Figure 5-2, connect positive lead (RED) of power cord to positive battery (+) and the negative lead (BLACK) to negative battery (-). A fuse holder is connected in series with the positive lead of the power cord. An 8 ampere fuse is provided for short circuit protection. This fuse will blow if the battery leads are connected incorrectly.

CAUTION

Do not connect the RAY-48A to a positive-ground electrical system (battery (+) connected to hull).

CAUTION

Never replace fuse with greater than 8A or serious and extensive damage will result.

The power cord is designed to carry the required current without undue voltage drop. If a longer run is needed, use conductors of adequate gauge for the added length under full transmitting load, and make corrections directly to the battery. Where a separate power supply is used for converting ship's 32-volt or 115-volt supply to 12 volts DC, it should be located within the length of the RAY-48A power cord.

5.3 GROUNDING

Special grounding is not necessary for the radiotelephone installation. However, when the radiotelephone is mounted on an ungrounded surface, the mounting yoke should be grounded to the hull. Bare copper wire or shielded braid is suitable as a grounding conductor.

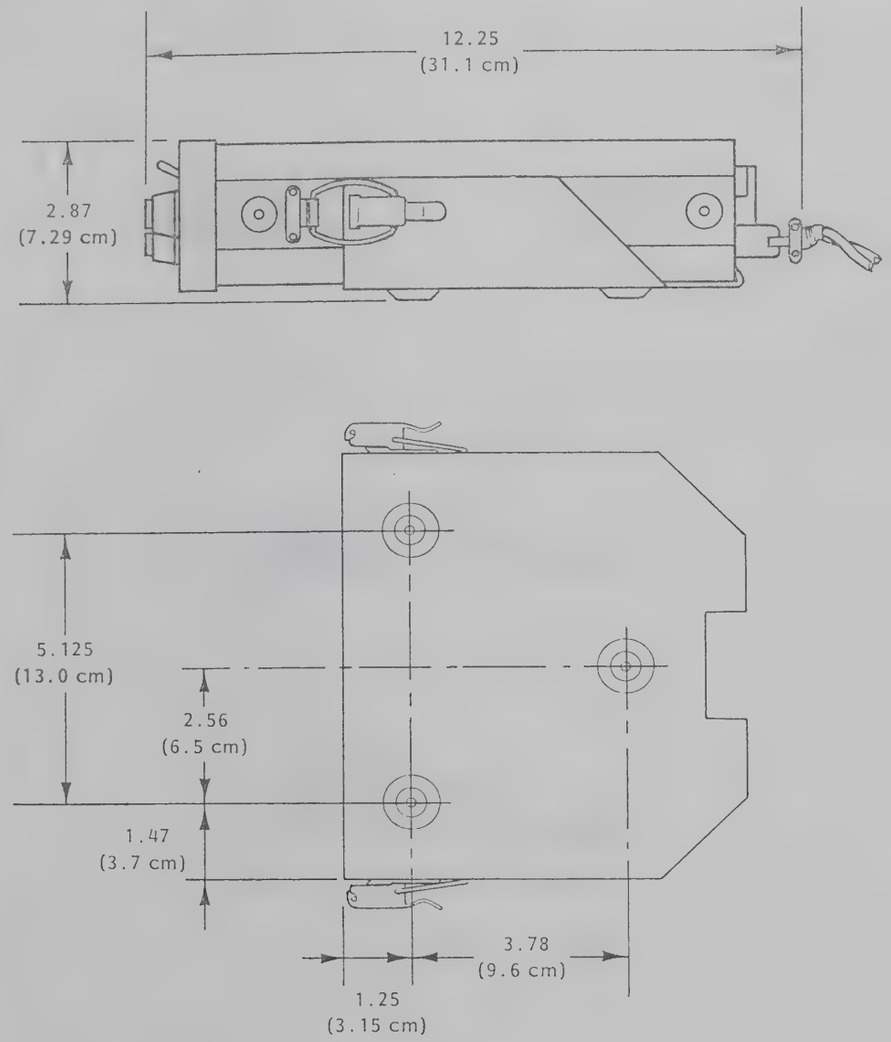


Figure 5-1 RAY-48A Outline and Mounting Dimension

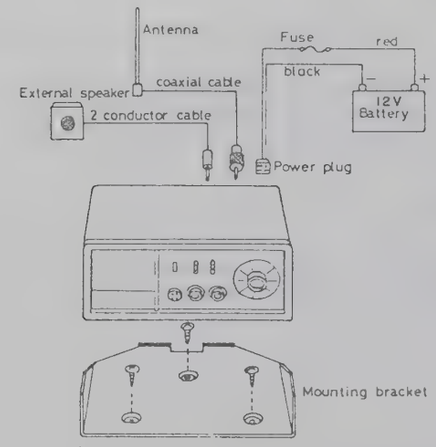


Figure 5-2 Installation of the RAY-48A

5.4 SELECTING AND INSTALLING THE ANTENNA

If in doubt concerning installation of an antenna, your dealer from whom you purchased the RAY-48A will be able to advise which type of antenna and mounting is best suited to your craft.

Should you install the antenna yourself, hardware and mounting instructions will be furnished with the antenna. It is recommended that type RG-8/U coaxial cable be used where the cable length exceeds the length of cable provided with the antenna.

Be sure that the mounting surface is strong enough, or that it is adequately reinforced to withstand wind and heavy weather. If a backing plate is needed, its thickness should be at least 1/4-inch for steel and 3/4-inch for wood.

Some of the locations for the antenna on various types of craft are illustrated in Figure 5-3. It is desirable to keep the coaxial cable as short and direct as consistent with a good antenna location. When a compromise must be made, the antenna should receive preference and be mounted in the highest and clearest location, regardless of the cable length. The coaxial cable is completely shielded and will not pick up interference. There is some radio frequency power lost in the cable; however, the typical pleasure craft installation will not require a cable of such length that this will be of significance.

Figure 5-3 Typical Antenna Locations on Various Types of Craft

5.5 INSTALLING ADDITIONAL CHANNELS

Installation of crystals, adjustments, tune-up and other requirements to activate additional channels must be performed by an FCC-licensed technician. Instructions for alignment and adjustment are provided in Section 7.

5.6 MOUNTING MICROPHONE AND EXTERNAL SPEAKER

The microphone holder provided with the radiotelephone can be mounted to the case of the unit by removing the paper from the bracket. The bracket has a glue already attached to the metal, and will adhere instantly to the metal case. To mount the bracket at another location, two number 6 sheet metal screws are provided. Plug the microphone connector into the microphone jack located on the front panel of the unit.

If an external speaker is to be installed, connect the speaker (4-ohm impedance and more than 3 watts input power) to the plug provided with the unit. Connect the external speaker plug into the external speaker jack located in the rear of the unit.

SECTION 6

THEORY OF OPERATION

6.1 RECEIVER (Figure 6-1)

The receiver utilizes a double-conversion superheterodyne circuit with crystal control for both local oscillators. First mixer Q12 receives channel injection frequency at 16.9 MHz below the signal frequency from amplifier Q23. First local oscillator (Q21) frequencies are generated in the 46 MHz range and tripled into the 139 to 145 MHz range by tripler stage, Q22. Weather channel crystals Y213 and Y214 are in separate circuits from the channel crystals Y201 through Y212. Center position toggle switch S2 activates the selected weather crystal and excludes operation on the two-way channels. An example of first conversion for WI is that the local oscillator crystal frequency at 48.5500 MHz is tripled to 145.65 MHz and mixed with the signal frequency of 162.550 MHz, producing the intermediate frequency of 16.9 MHz. This is applied to crystal filter FL-1, which rejects the unwanted difference frequencies and provides the desired passband.

Crystal filter FL-1 provides a 6dB bandwidth of 13 kHz at the 16.9 MHz intermediate frequency. Direct-coupled IF amplifiers Q13 and Q14 amplify the 16.9 MHz signal which is coupled by L141 to the base of second mixer Q15.

Second local oscillator (Q16) is crystal-controlled by Y161 at 16.455 MHz. This frequency is coupled to the emitter of Q15. The difference between the first IF (16.9 MHz) and 16.455 MHz generates the second IF which is 455 kHz.

The 455 kHz output from the second mixer is fed through L151 to the input of an integrated circuit IF amplifier (Q17). The 455 kHz output of Q17 drives a double-diode discriminator. The audio output of the discriminator is amplified by audio amplifiers, Q18 and Q19.

The audio output from the discriminator is fed to the squelch amplifier and audio amplifier through the volume control. Audio output is provided by the audio IC to the speaker.

The squelch circuit consists of the front panel squelch control (VR331), noise amplifier (Q31, Q32) and two switching transistors (Q33, Q34). The squelch circuit operates by detecting the effect a received radio signal has upon the noise output of the discriminator. When a radio station signal is received, this noise level is reduced in proportion to the strength of the signal. The sensitivity of the squelch circuit is controlled by the setting of the front panel SQUELCH control and the squelch level control (VR191) on the PC board.

When no radio station signal is being received, the noise output from the discriminator is fed through the two squelch controls to the input of the noise amplifier (Q31,32). The amplified noise output is applied to the base of the switch transistor (Q33) causing it to conduct. When Q33 conducts, forward bias is removed from Q34, thereby turning it off. When Q34 is turned off, a positive voltage is applied to the emitter of the first audio amplifier (Q18) turning it off and silencing the speaker.

When a radio station signal is received, the noise input to Q31 is reduced, causing transistor Q33 to turn off. When Q33 is off, Q34 is forward biased, thereby removing the positive voltage applied to the emitter of audio amplifier transistor (Q18) and permitting the audio signal to pass through to the speaker.

6.2 TRANSMITTER (Figure 6-1)

The transmitter crystal oscillator transistor (Q41) uses 6.5 MHz fundamental crystals. The oscillator output is coupled to the modulator circuit. The signal modulated by the audio signal from the audio section is fed to amplifier (Q43) and tripled by Q44. Then the 19.5 MHz output from the tripler is inductively coupled to the following doubler Q45. The doubled 39 MHz output is coupled to the next doubler circuit by the same method, and that doubled 78 MHz output to the next doubler circuit. The final frequency is obtained by the last multiplier (Q47). All multiplier circuits consist of a transistor and double tuned tank coil to eliminate the unwanted harmonics. The output from the last doubler is fed to the following predriver amplifier (Q48), amplified, and then coupled to the second predriver. The second predriver, driver, and power transistors (Q49, Q50, Q51) are located on the RF power amplifier PC board. The output of the power amplifier is coupled to the 50-ohm antenna through the antenna filter and relay.

The transmitter audio amplifier circuitry consists of a dynamic microphone, a transistor amplifier, an instantaneous speech clipper, and an audio roll-off filter.

The RF power reduction is made by reducing the DC voltage supplied to the driver and power amplifier. The 25W and 1W power change circuit consists of changeover switch and voltage control VR711. When the switch is in the 25W position the DC source power is directly supplied to the RF circuit. When in the 1W position the DC voltage is reduced so that the RF power output is not more than 1 watt.

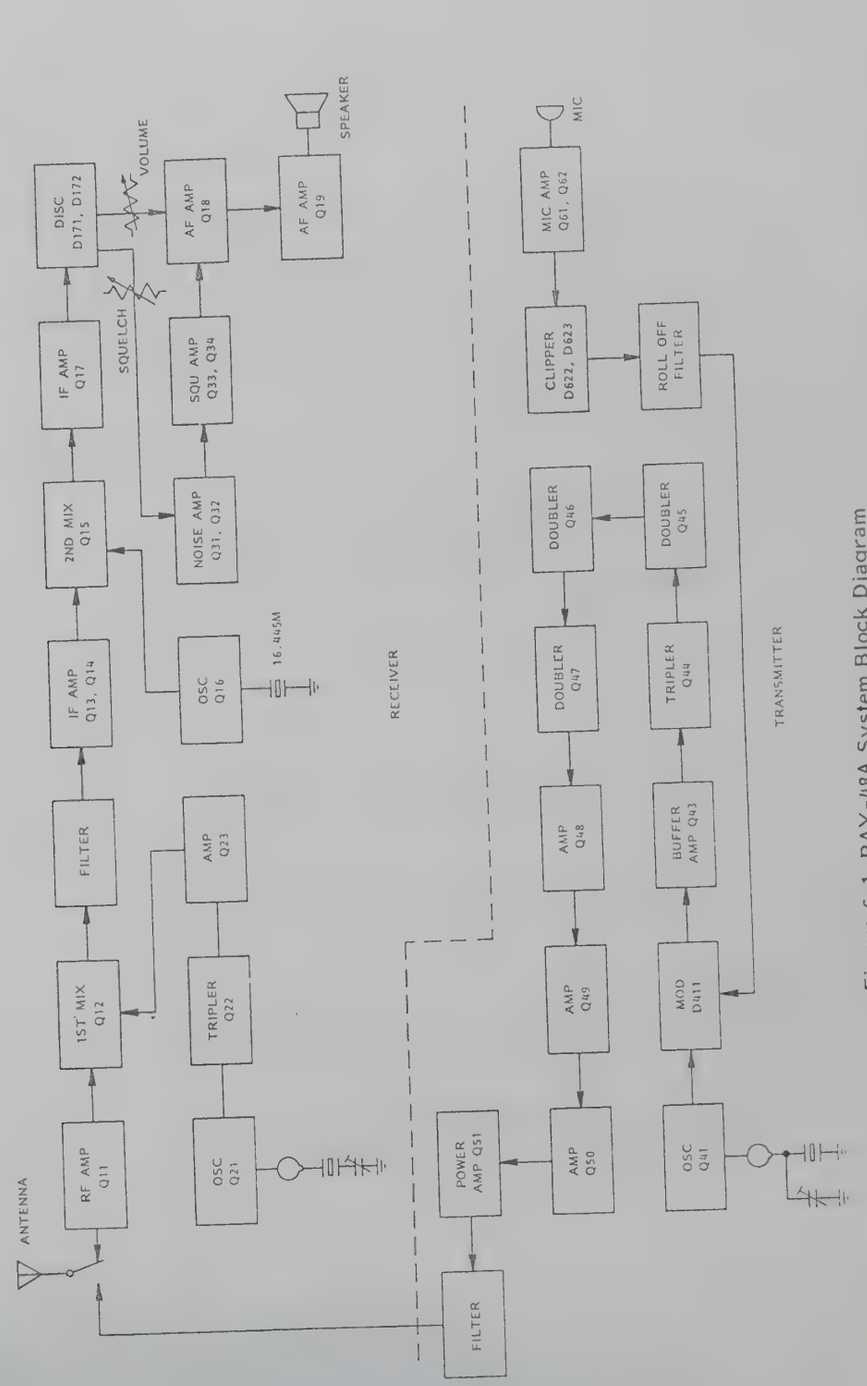


Figure 6-1 RAY-48A System Block Diagram

SECTION 7

MAINTENANCE

7.1 GENERAL

For optimum performance, periodic checks should be performed by qualified personnel. Servicing may be simplified by reference to the schematic diagram. To localize the cause of trouble, eliminate those sections of the equipment which are operating normally. When the faulty section is localized, its individual components are tested to identify the problem.

7.2 BASIC MAINTENANCE PROGRAM

For maximum performance a bimonthly program of preventive maintenance should include the following:

1. Check plugs, connectors, fuses, and fasteners for proper seating. Clean electrical connections.

2. Remove any accumulated dust with a small brush or dry compressed air.

3. Check battery connections. Add water and clean terminals as required.

4. Check the antenna system carefully. Look for corroded coaxial plugs or socket connections as well as cracked coax jacketing. Check isolation of center coax conductor and outer shield. Check resistance between connections.

5. Check input power system for loose fuse connections and corrosion at plugs and receptacles. Check wiring for kinks, pinches, and abrasions.

6. Check radiotelephone for optimum performance. Receiver sensitivity should be better than 0.5 uV for 20 dB quieting. Transmitter output should be 25 watts at nominal input voltage (13.6V).

7. Check transmitter power to antenna system using a thruline type RF wattmeter. Power should be 25 watts at nominal input voltage (13.6V).

8. Check antenna reflected power using a thru-line type wattmeter. Reflected power should be negligible if the antenna and transmission line are working properly.

The following test instruments and accessories are required for aligning, checking and maintaining the RAY-48A.

Equipment	Manufacturer and Model No.
AC VTVM (RF)/Voltmeter	Hewlett Packard HP410
Frequency Counter	Hewlett Packard HP5382A
Oscilloscope	Tektronix 475 (200 MHz) or 335 (35 MHz)
Power Supply (13.6 VDC @ 7.5 amperes)	Sorensen
Signal Generator (AF)	Hewlett Packard HP200CD
Signal Generator (RF)	Hewlett Packard HP202H
VOM	Simpson 260
Dummy Load (50-ohm)	Bird 8130
Wattmeter	Bird 43 (with model 50C and 1C element)
Frequency Meter/Signal Generator)	Singer FM10C
Deviation Meter	Measurements 920
Sweep Generator	As available

7.3 INSTALLING ADDITIONAL OR NEW CHANNELS

Crystals for six transmit and receive channels (6, 16, 22A, 68, 26 and 28) and two weather channels (162.550 MHz and 162.400 MHz) are already installed for immediate operation.

Additional or new channels will require installation of a transmit and receive crystal for each channel. Your local marine, USCG Auxiliary, or USCG office will be able to furnish information on new channels in your area.

Installation of new crystals requires that your unit be aligned for the exact transmit and receive frequencies. FCC regulations require that frequency adjustments be made by the holder of a First or Second Class Commercial Radiotelephone License, and that the change or addition be logged in by the licensed technician.

To determine the crystal frequency needed for the channel desired use the following formulas:

$$\text{Receive crystal oscillation freq (MHz)} = \frac{\text{Channel receive freq (MHz)}}{3}$$

$$\text{Transmit crystal oscillation freq (MHz)} = \frac{\text{Adjustment freq (MHz)}}{24}$$

NOTE

A channel decal sheet, on which numbers for all VHF/FM marine band channels are printed on a transparent paper, is supplied with the unit. When adding new channels, peel off the required channel numbers from the decal sheet and affix them to the channel selector dial.

When replacing crystals the basic part number, 394-7224-G(x), which identifies the crystal pair, must be specified as well as the specific channel designation.

NOTE

Only crystals designed specifically for this equipment should be installed. Other crystals may appear to function satisfactorily, but will not be dependable under all conditions and will not maintain carrier frequency stability within legal limits.

Channel	Selector Position	Use
6	1	
16	2	
22A	3	
26	4	(Refer to Table 7-1)
28	5	
68	6	
WX	(W1) (W2)	

Table 7-1 furnishes a suggested plan for installing additional or new channels.

Table 7-2 specifies Simplex and Duplex channels and their corresponding crystals. To determine the crystal frequency required use the formulas which follow.

$$\text{Receive crystal oscillation freq (MHz)} = \frac{\text{Channel receive freq (MHz)}}{3}$$

$$\text{Transmit crystal oscillation freq (MHz)} = \frac{\text{Adjustment freq (MHz)}}{24}$$

Table 7-1 Recommended Commercial and Noncommercial Channels for the RAY-48A

Channel Number	TYPE OF COMMUNICATIONS Points of Communications	Commercial	Noncommercial
16 (mandatory)	DISTRESS, SAFETY & CALLING Intership, ship-to-shore	1	1
06 (mandatory)	INTERSHIP SAFETY Intership, ship-to-coast	1	1
22A	USCG LIAISON	1	1
26, 28	Marine Radiotelephone Operators	2	2
65,66,12,73, 14,74,20	PORT OPERATIONS Intership, ship-to-coast	2	2
13	NAVIGATIONAL Intership, ship-to-coast	1	1
W1, W2	ENVIRONMENTAL Ship receive only	Receive only	Receive only (2)
07, 09, 10, 11, 18, 19, 79, 80	COMMERCIAL Intership, ship-to-coast	2	
67, 08, 77 88	COMMERCIAL Intership	2	
68	NONCOMMERCIAL Intership, ship-to-coast		1
09, 69, 71, 78	NONCOMMERCIAL		2
70, 72	NONCOMMERCIAL Intership		1

Table 7-2 Crystal Frequencies Required for Essential Channels

CHANNEL	RECEIVER FREQUENCY (MHz)			TRANSMITTER	FREQUENCY (MHz)
	F_{RX}	F_{INJ}	$F_{XTAL}(RX)$	F_{TX}	F_{XTAL} (TX)
6	156.3	139.4	46.46667	156.3	6.51250
7	156.35	139.45	46.48333	156.35	6.51458
8	156.4	139.5	46.50000	156.4	6.51667
9	156.45	139.55	46.51667	156.45	6.51875
10	156.5	139.6	46.53333	156.5	6.52083
11	156.55	139.65	46.55000	156.55	6.52292
12	156.6	139.7	46.56667	156.6	6.52500
13	156.65	139.75	46.58333	156.65	6.52708
14	156.7	139.8	46.60000	156.7	6.52917
15	156.75	139.85	46.61667	-------	-------
16	156.8	139.9	46.63333	156.8	6.53333
17	156.85	139.95	46.65000	156.85	6.53542
18	156.9	140.0	46.66667	156.9	6.53750
19	156.95	140.05	46.68333	156.95	6.53958
20	161.6	144.7	48.23333	157.0	6.54167
22A	157.1	140.2	46.73333	157.1	6.54583
24	161.8	144.9	48.30000	157.2	6.55000
25	161.85	144.95	48.31667	157.25	6.55208
26	161.9	145.0	48.33333	157.3	6.55417
27	161.95	145.05	48.35000	157.35	6.55625
28	162.0	145.1	48.36667	157.4	6.55833
68	156.425	139.525	46.50833	157.425	6.51771
70	156.525	139.625	46.54167	157.525	6.52188
W2	162.4	145.5	48.50000	-------	-------
W1	162.55	145.65	48.55000	-------	-------

7.4 FREQUENCY ADJUSTMENT

1. Install the receive and transmit crystals in accordance with Table 7-2. Allow 15 minutes for the crystal oven to stabilize, after which the channel frequency may be set by adjusting the capacitors listed in Table 7-3.

Table 7-3 Crystal Trimmer Capacitors for Each Position of Channel Selector Switch

Channel Position	Trimmer Capacitor	
	Transmit	Receive
1 (ch 6)	VC411	VC201
2 16	VC412	VC202
3 22A	VC413	VC203
4 26	VC414	VC204
5 28	VC415	VC205
6 68	VC416	VC206
7	VC417	VC207
8	VC418	VC208
9	VC419	VC209
10	VC420	VC210
11	VC421	VC211
12	VC422	VC212
W1		VC213
W2		VC214

2. Set the transmitter frequency by sampling the transmitter output with a frequency counter, adjusting the frequency to within $\pm$ 50 Hz of the assigned frequency.

3. Set the receiver local oscillator frequency by connecting a frequency counter to a pickup loop set near the local oscillator or to TP231.

PRELIMINARY ALIGNMENT AND CHECKOUT

Receiver

a. Sensitivity

Quieting: Not more than 0.5 microvolt for 20 dB quieting.
Sinad: Not more than 0.35 microvolt for 12 dB Sinad.

b. Audio Power Output

A one-millivolt RF signal, modulated with 1000 Hz at 3.3 kHz deviation should produce not less than 1.5 watts audio at the speaker.

c. Squelch Sensitivity

Not more than 0.5 microvolt at threshold. Tight squelch not more than 2 microvolts.

Transmitter (Figure 7-1)

a. Power Output

1. Connect RF wattmeter and 50 ohm load to antenna jack.

2. Set POWER switch to HIGH and channel selector switch to channel 16. Key the transmitter and check for rated output power (25W nominal) at 13.6 volts.

3. Set POWER switch to 1W. Check for not more than 1W output. If necessary adjust VR711 to obtain no more than 1W output.

b. Modulation Deviation

1. Connect an audio signal generator across microphone input terminal and adjust frequency to 2500 Hz at 4 mv with suitable capacitive isolation.

2. Key transmitter on channel 16 and increase audio level until deviation is 3.5 kHz. Increase audio level an additional 20 dB.

3. Swing generator frequency from 1 to 4 kHz and set deviation control VR622 such that 5 kHz is not exceeded. Check remaining channels to assure that 5 kHz deviation is not exceeded.

4. Replace microphone.

5. Check that ± 5.0 kHz is not exceeded on a loud whistle or yell, and the deviation does not go below ± 3.5 kHz when a normal soft voice is used.

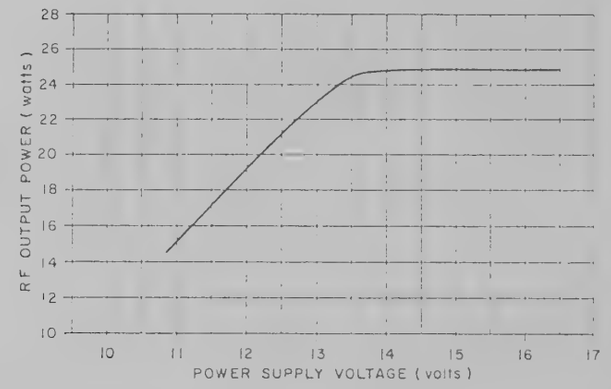


Figure 7-1 Output Power Vs Supply Voltage

7.6 TRANSMITTER ALIGNMENT

NOTE

Microphone PRESS TO TALK switch must be depressed to obtain drive.

7.6.1 Oscillator and Buffer

1. Set channel selector to any position where a crystal is installed.

2. Using VOM, check dc drive developed at TP441 (input of the transmit multiplier). If oscillator is operating properly, voltage will be approximately 1.2 Vdc. With no drive it will be approximately 0.2 Vdc.

3. Tune L412 and L431 for a maximum dc indication at TP441 with channel selector set to channel 16.

7.6.2 Transmit Multiplier

1. Set channel selector to channel 16.

2. Connect VOM to TP451 and tune L441 and L442 for maximum indication. Readjust L441/L442 as necessary for approximately equal indications on channels 6 and 26. Voltage should be approximately 0.25 Vdc with drive from the transmit oscillator and approximately 0.12 Vdc with no drive.

3. Connect VOM to TP461 and tune L451 and L452 for maximum indication. Readjust L451/L452 as necessary for approximately equal indications on channels 6 and 26. Voltage should be not less than 0.5 Vdc with drive.

4. Connect VOM to TP471 and tune L461 and L462 for maximum indication. Readjust L461/L462 as necessary for approximately equal indications on channels 6 and 26. Voltage should be not less than 0.6 Vdc with drive.

7.6.3 RF Power Amplifier

1. Connect RF wattmeter and 50 ohm load to antenna connector J1.

2. Set channel selector to channel 16.

3. Set RF PWR switch to 25W.

4. If power output is indicated at J1, adjust trimmers VC471, VC483, VC491, VC492, VC501, VC502, VC512 and VC513 for maximum power output.

NOTE

If no rf power output is indicated on the wattmeter, tune the individual stages (steps 5 through 10).

5. Connect VOM to TP501.

6. Adjust capacitors VC471, VC483, VC491, and VC492 for maximum indication.

7. Transfer VOM to TP502.

8. Adjust VC501 and VC502 for maximum indication.

9. Adjust VC512 and VC513 for maximum rf output on the wattmeter.

10. Again touch up all tuning capacitors for maximum rf output.

7.6.4 Low Power Output Adjustment

1. Set RF PWR switch to 2W.

2. Adjust VR711 for one watt RF output.

7.6.5 Modulator Deviation

1. Connect 50 ohm RF load to antenna terminal.

2. Connect AF frequency generator to microphone input terminal using 0.47 microfarad for DC isolation.

3. Adjust AF generator for 2500 Hz at 4 mV output.

4. Preset deviation control VR622 for maximum deviation.

5. Preset deviation balance control VR621 to its center position.

6. Adjust microphone gain control VR611 to obtain 3.5 kHz deviation.

7. Increase audio level by 20 dB and adjust VR622 to limit deviation to 4.5 kHz, making sure of plus and minus deviation.

> *NOTE*
>
> *Balancing must be done by adjusting VR621.*

8. Replace microphone and check that deviation does not exceed ± 5.0 kHz on a loud whistle or yell. Also check that deviation does not go below ± 3.5 kHz during normal quiet speech.

7.6.6 18.5 kHz Filter (L621)

Filter L621 is located between the limiter and modulator circuits, and is factory-tuned to 18.5 kHz (per FCC regulations, Part 83). The tuning of this filter is quite broad, and will normally require no field servicing. To check this function, proceed as follows:

1. Connect AC VTVM across R627.
2. Insert a 1000 Hz, 4 mv signal at the microphone input. Note indication across R627.
3. Adjust input signal frequency to 18.5 kHz at 4 mV. The output across R627 should be no less than 50 dB below that at 1 kHz.

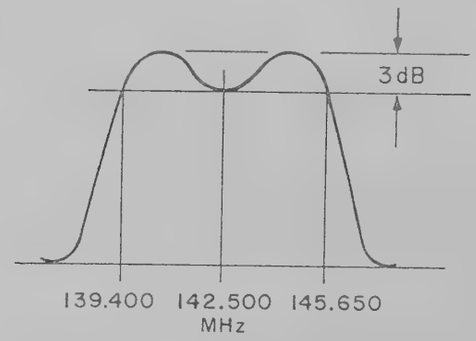
7.7 RECEIVER ALIGNMENT

> *CAUTION*
>
> *Use extreme care when tuning the tank coils of the local oscillator and rf amplifier. The alignment of these circuits is critical.*

7.7.1 Local Oscillator

> *NOTE*
>
> *In some sets the PCB marking incorrectly indicates L211 for L215. L211 is not adjustable.*

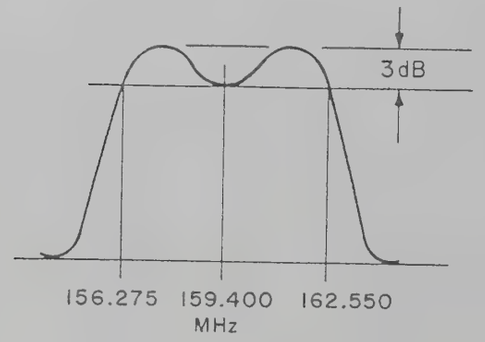
1. Connect AC VTVM to TP211. Carefully adjust L215 for equal output indications with channel selector on channels 6 and W2 (if installed, otherwise on W1).
2. Connect oscilloscope to TP121.
3. Connect a sweep generator (138-146 MHz) to TP211.
4. Carefully adjust L221, L231 and L232, L233 for maximum amplitude, and waveform pattern shown below.



7.7.2 RF Amplifier

a. *Preferred Method*

1. Connect a sweep generator (155-163 MHz) to antenna input connector J1, and an oscilloscope to TP121.
2. Carefully adjust coils L111, L112, L113 and L121 for maximum amplitude and waveform pattern shown below.



b. *Alternate Method* (sweep generator not available)

1. Connect rf signal generator, set to mid-band (159.4 MHz) at 100 mV, to antenna input J1.

2. Temporarily connect a 1000 pF capacitor across L113.

3. Connect AC VTVM to the junction of C102/C105 (top of L111).

4. Adjust L111 and L112 for peak/minimum indications respectively.

5. Connect AC VTVM to gate of Q11 (at junction of C104/R111/R112). Retune L111 for peak indication.

6. Remove 1000 pF capacitor from L113.

7. Connect AC VTVM to drain (D) of Q11 (junction of C119/L113). Adjust L113 and L121 for maximum/minimum indications respectively.

8. Connect AC VTVM to gate of Q12 (junction of C123/C124). Retune L113 for peak indication.

7.7.3 IF Amplifier

> *NOTE*
>
> *The channel 16 receiving crystal frequency must be accurately adjusted prior to alignment.*

1. Connect VOM, set to the 1V scale, to TP181.

2. Connect audio voltmeter across speaker terminals.

3. Connect a signal generator to TP151. Set frequency to 455 kHz ±50 Hz. Set the channel selector to a channel without a crystal.

4. Tune L151 and L171 for maximum indication at speaker output.

5. Tune L172 for zero discriminator voltage at TP181. Remove the 455 kHz generator.

6. Connect rf signal generator to antenna connector (J1). Set output for 156.8 MHz ±50 Hz, modulated 3.3 kHz deviation at 1000 Hz.

7. Set channel selector to position 2 (ch 16) making sure that the receive frequency has been set within limits (± 100 Hz).

8. Recheck discriminator for zero voltage at TP181 without modulation. If not within 0.15 volt, reset L172. This will produce a symmetrical waveform at the speaker.

9. Fine tune signal generator so that a symmetrical audio waveform is observed on oscilloscope. Reduce generator level so that the audio waveform becomes noisy.

10. Tune L122 and L141 for maximum audio output.

7.8 TROUBLESHOOTING

7.8.1 Receiver Operational Checks

1. Inject a dc-isolated, 1 kHz 1 mV rms signal at TP181. Approximately 5V rms should appear at speaker terminals with VOLUME control advanced fully clockwise.

2. To check injection from local oscillator, connect DC VTVM to TP231. This voltage should be approximately 1 Vdc, and 1.5 Vdc in ch 6 and WX positions.

3. With channel selector in position 1 (ch 6), inject a signal at the antenna connector. Receiver quieting should be 20 dB quieting for a 0.5 microvolt input. With no signal, noise should be present.

4. With no signal, rotate SQUELCH control clockwise to quiet the noise. Inject ch 6 signal again and note that squelch appears with less than 0.5 microvolt input.

7.8.2 Transmitter Operational Checks

1. Key transmitter on ch 16, and check following dc voltages:

Test Point	DC Voltage
TP 441	1.2
TP 441	0.2 (without osc drive)
TP 451	0.25
TP 461	0.5
TP 471	0.6
TP 501	0.1
TP 502	0.3

2. Check for 25W/1W power output at antenna connector J1.

3. Check for proper deviation: insert an audio tone of 2.5 kHz at not less than 40 millivolts into the microphone input. A frequency-modulated deviation meter should indicate 5 kHz deviation.

> *NOTE*
>
> *If an AF signal generator is unavailable, whistling will provide an approximate indication of deviation.*

7.8.3 Receiver DC Voltages

Set up the front panel controls as follows:

Control	Position
Channel selector	1 (ch 6)
VOLUME	midrange
SQUELCH	fully CCW
WX	OFF

Using a VTVM, check voltage at points indicated in Table 7-4.

Table 7-4 Receiver DC Voltage Chart

Transistors

Symbol	Base	Emitter	Collector
Q21	1.4	1.0	6.5
Q22	1.15	0.4	7.0
Q23	2.0	1.4	10.0
Q15	1.3	0.9	12.0
Q16	2.0	1.5	11.5
Q33	0.4	0.85	7.0
Q34	1.5	0.85	1.0
Q18	1.1	0.65	6.5

Field Effect Transistors (FET)

	Gate 1	Gate 2 (V)	Source	Drain
Q11	0.8	1.7	1.4	7.8
Q12	0	3.6	1.3	7.8

Integrated Circuits (IC)

	1	2	3	4	5	6	7	8	9	0
Q17	2.0	2.0	8.5	0	9.0	1.7	1.7	---	---	---
Q19	NC	NC	0	6.5	13.8	10.5	6.5	11.5	6.5	5.5

7.8.4 Transmitter DC Voltages

1. Set channel selector position 6 (ch 16) RF PWR switch to 1W.

2. Using VTVM, check voltage at positions indicated in Table 7-5.

Table 7-5 Transmitter DC Voltage Chart*

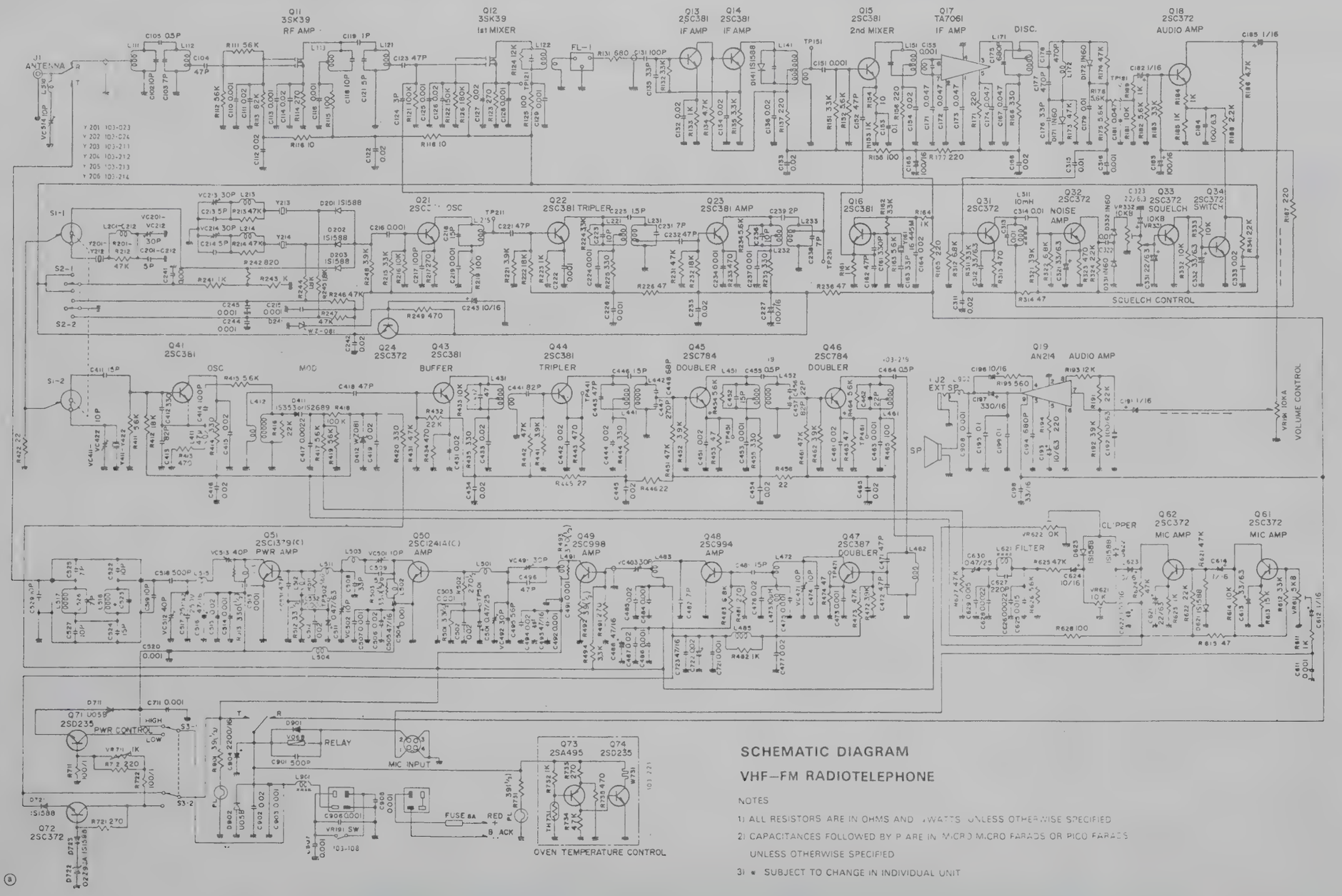
Symbol	Base	Emitter	Collector
Q41	1.3	1.0	6.5
Q43	1.0	0.7	10.0
Q44	0.35 (0.7)	0.2 (0.01)	10.0
Q45	0.15 (0.65)	0.2 (0.03)	10.0
Q46	1.2 (0.65)	0.7 (0.03)	10.0
Q47	0.7 (0.65)	0.9 (0.03)	13.5
Q48	0.2	0	13.5
Q49	0.75	0	13.5
Q50	0.65	0	13.5
Q51	0.4	0	13.5

* Transmitter must be keyed on an active channel.

SECTION 8

SCHEMATIC DIAGRAM AND PARTS LIST

This section contains the schematic diagram and a list of electrical and mechanical components arranged according to their circuit symbols. Components in the 100 series are in the receiving circuit, while components in the 400 series are in the transmitter. Note that on schematic diagram, Figure 8-1, electrolytic capacitor values and working voltages indicated (e.g., C191 1/16; C621 (emitter of Q62) 22/6.3) the first number is the value in microfarads; the second is the voltage rating.



SCHEMATIC DIAGRAM

VHF–FM RADIOTELEPHONE

NOTES

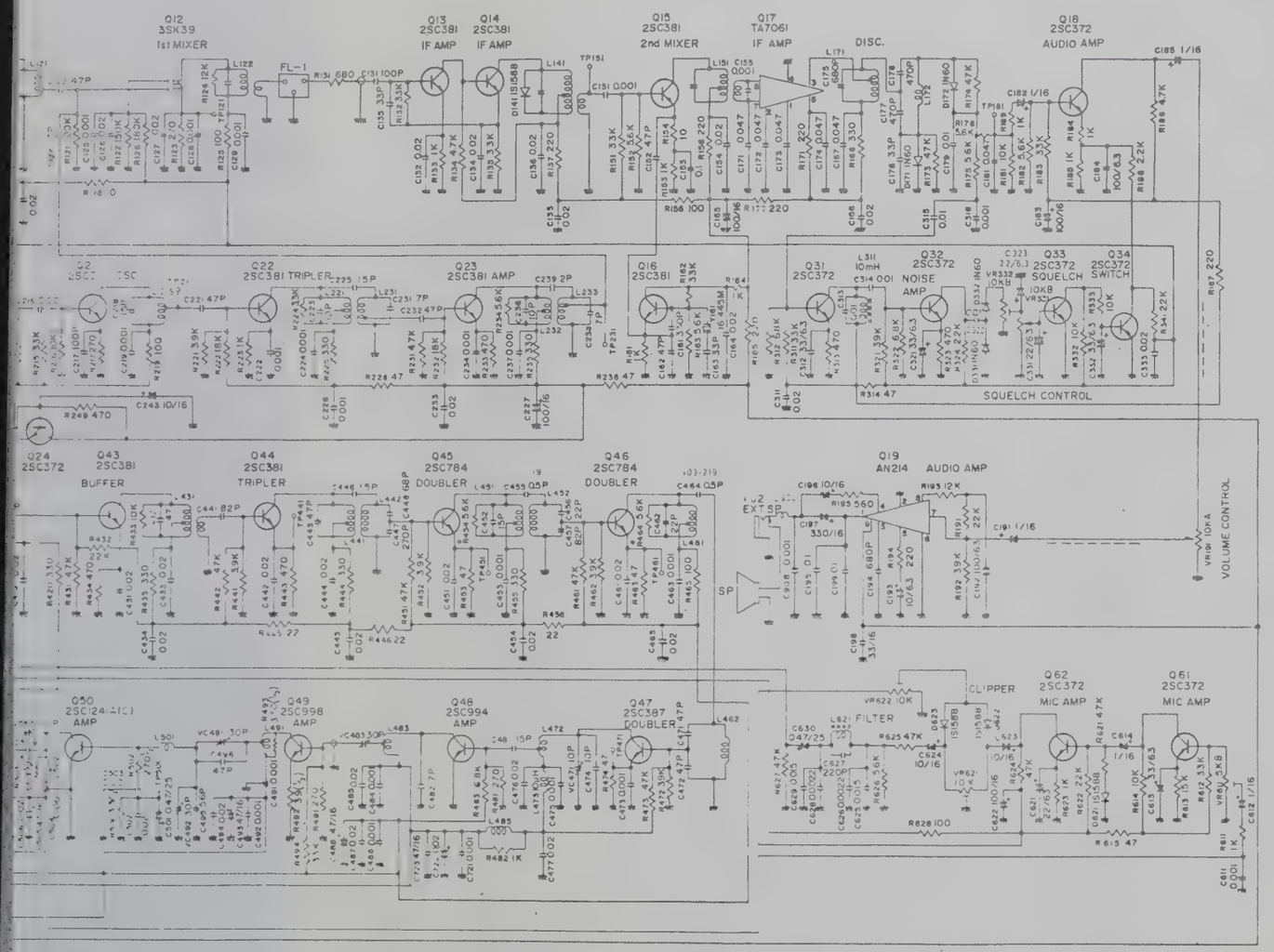
1) ALL RESISTORS ARE IN OHMS AND ¼WATTS UNLESS OTHERWISE SPECIFIED

2) CAPACITANCES FOLLOWED BY P ARE IN MICRO MICRO FARADS OR PICO FARADS UNLESS OTHERWISE SPECIFIED

3) * SUBJECT TO CHANGE IN INDIVIDUAL UNIT

Circuit Symbol	Description	Part Numb
Capacitor, Fixed		
C101	5pF, Mica	235-7053F
C102	10pF, Mica	235-7355F
C103	7pF, Mica	235-7053F
C104	47pF, Mica	235-7355F
C105	.5pF, Mica	587968-7
C106		Not used
C107		Not used
C108		Not used
C109		Not used
C110	.001uF, Ceramic	235-7195F
C111	.02uF, Ceramic	235-7207
C112	.02uF, Ceramic	235-7207
C113	.001uF, Ceramic	235-7195
C114	.02uF, Ceramic	235-7207
C115		Not used
C116	.001uF, Ceramic	235-7195
C117		Not used
C118	10pF, Mica	235-7355
C119	1pF, Mica	235-7355
C120		Not used
C121	5pF, Mica	235-7053
C122	.02uF, Ceramic	235-7207
C123	47pF, Mica	235-7355
C124	3pF, Mica	235-7355
C125	.001uF, Ceramic	235-7195
C126	.02uF, Ceramic	235-7207
C127	.02uF, Ceramic	235-7207
C128	.001uF, Ceramic	235-7195
C129	.001uF, Ceramic	235-7195
C130		Not used
C131	100pF, Mica	235-7355
C132	.02uF, Ceramic	235-7207
C133	.02uF, Ceramic	235-7207
C134	.02uF, Ceramic	235-7207
C135	33pF, Mica	235-7053
C136	.02uF, Ceramic	235-7207
C137 through C150		Not used
C151	.001uF, Ceramic	235-7195
C152	47pF, Mica	235-7355
C153	0.1uF, Ceramic	169256-4
C154	.02uF, Ceramic	235-7207
C155	.001uF, Ceramic	235-7195
C156 through C160		Not used
C161	330pF, Mica	235-7053
C162	47pF, Mica	235-7355
C163	33pF, Mica	235-7053
C164	0.02uF, Ceramic	235-720
C165	100uF, 16V, Electrolytic	235-7197
C166		Not used
C167	.047uF, Mylar	235-735
C168		Not use
C169		Not use
C170		Not use
C171	.047uF, Mylar	235-735
C172	.047uF, Mylar	235-735
C173	.047uF, Mylar	235-735
C174	.047uF, Mylar	235-735
C175	680pF, Mica	235-735
C176	33pF, Mica	235-705
C177	470pF, Mica	235-735
C178	470pF, Mica	235-735
C179	.01 Mylar	235-739
C180		Not use
C181	.047 Mylar	235-735
C182	1uF/16VDCW, Electrolytic	235-739
C183	100uF/16VDCW, Electrolytic	235-719

Figure 8-1 RAY-48A VHF FM Marine Radiotelephone Schematic Diagram



SCHEMATIC DIAGRAM

VHF—FM RADIOTELEPHONE

NOTES

1) ALL RESISTORS ARE IN OHMS AND ..WATTS UNLESS OTHERWISE SPECIFIED

2) CAPACITANCES FOLLOWED BY P ARE IN MICRO MICRO FARADS OR PICO FARADS UNLESS OTHERWISE SPECIFIED

3) • SUBJECT TO CHANGE IN INDIVIDUAL UNIT

Figure 8-1 RAY-48A VHF FM Marine Radiotelephone Schematic Diagram

RAY-48A PARTS LIST

Circuit Symbol	Description	Part Number
Capacitor, Fixed		
C101	5pF, Mica	235-7053P1
C102	10pF, Mica	235-7355P401
C103	7pF, Mica	235-7053P3
C104	47pF, Mica	235-7355P6
C105	.5pF, Mica	587968-75
C106		Not used
C107		Not used
C108		Not used
C109		Not used
C110	.001uF, Ceramic	235-7195P2
C111	.02uF, Ceramic	235-7207P32
C112	.02uF, Ceramic	235-7207P32
C113	.001uF, Ceramic	235-7195P2
C114	.02uF, Ceramic	235-7207P32
C115		Not used
C116	.001uF, Ceramic	235-7195P2
C117		Not used
C118	10pF, Mica	235-7355P401
C119	1pF, Mica	235-7355P31
C120		Not used
C121	5pF, Mica	235-7053P1
C122	.02uF, Ceramic	235-7207P32
C123	47pF, Mica	235-7355P6
C124	3pF, Mica	235-7355P2
C125	.001uF, Ceramic	235-7195P2
C126	.02uF, Ceramic	235-7207P32
C127	.02uF, Ceramic	235-7207P32
C128	.001uF, Ceramic	235-7195P2
C129	.001uF, Ceramic	235-7195P2
C130		Not used
C131	100pF, Mica	235-7355P33
C132	.02uF, Ceramic	235-7207P32
C133	.02uF, Ceramic	235-7207P32
C134	.02uF, Ceramic	235-7207P32
C135	33pF, Mica	235-7053P41
C136	.02uF, Ceramic	235-7207P32
C137 through C150		Not used
C151	.001uF, Ceramic	235-7195P2
C152	47pF, Mica	235-7355P6
C153	0.1uF, Ceramic	169256-49
C154	.02uF, Ceramic	235-7207P32
C155	.001uF, Ceramic	235-7195P2
C156 through C160		Not used
C161	330pF, Mica	235-7053P305
C162	47pF, Mica	235-7355P6
C163	33pF, Mica	235-7053P41
C164	0.02uF, Ceramic	235-7207P32
C165	100uF, 16V, Electrolytic	235-7199P12
C166		Not used
C167	.047uF, Mylar	235-7352P185
C168		Not used
C169		Not used
C170		Not used
C171	.047uF, Mylar	235-7352P185
C172	.047uF, Mylar	235-7352P185
C173	.047uF, Mylar	235-7352P185
C174	.047uF, Mylar	235-7352P185
C175	680pF, Mica	235-7355P422
C176	33pF, Mica	235-7053P41
C177	470pF, Mica	235-7355P272
C178	470pF, Mica	235-7355P272
C179	.01 Mylar	235-7396P13
C180		Not used
C181	.047 Mylar	235-7352P185
C182	1uF/16VDCW, Electrolytic	235-7395P46
C183	100uF/16VDCW, Electrolytic	235-7199P12

Circuit Symbol	Description	Part Number
Capacitor, Fixed		
C184	100uF/6.3VDCW, Electrolyt.	235-7199P12
C185	1uF/16VDCW, Electrolytic	235-7395P46
C186	.02uF, Mylar	169256-48
C187		Not used
C188		Not used
C189		Not used
C190		Not used
C191	1uF/16VDCW, Electrolytic	235-7395P46
C192	100uF/6.3VDCW, Electroly.	235-7199P12
C193	10uF/6.3VDCW, Electrolyt.	235-7199P4
C194	680pF, Mica	235-7355P422
C195	.01uF, Mylar	235-7396P13
C196	10uF/16VDCW, Electrolytic	235-7395P5
C197	330uF/16VDCW, Electrolyt.	169256-46
C198	33uF/16VDCW, Electrolytic	235-7395P55
C199	.01uF, Mylar	235-7396P13
C201	5pF, Mica	235-7053P1
C202	5pF, Mica	235-7053P1
C203	5pF, Mica	235-7053P1
C204	5pF, Mica	235-7053P1
C205	5pF, Mica	235-7053P1
C206	5pF, Mica	235-7053P1
C207	5pF, Mica	235-7053P1
C208	5pF, Mica	235-7053P1
C209	5pF, Mica	235-7053P1
C210	5pF, Mica	235-7053P1
C211	5pF, Mica	235-7053P1
C212	5pF, Mica	235-7053P1
C213	5pF, Mica	235-7053P1
C214	5pF, Mica	235-7053P1
C215	.001uF, Ceramic	235-7195P2
C216	.001uF, Ceramic	235-7195P2
C217	100pF, Mica	235-7355P33
C218	15pF, Mica	235-7053P12
C219	.001uF, Ceramic	235-7195P2
C220		Not used
C221	47pF, Mica	235-7355P6
C222	.001uF, Ceramic	235-7195P2
C223	10pF, Mica	235-7355P401
C224	.001uF, Ceramic	235-7195P2
C225	15pF, Mica	235-7053P12
C226	.001uF, Ceramic	235-7195P2
C227	100uF/16VDCW, Electrolyt.	235-7199P12
C228		Not used
C229		Not used
C230		Not used
C231	7pF, Mica	235-7053P3
C232	47pF, Mica	235-7355P6
C233	.02uF, Ceramic	235-7207P32
C234	.001uF, Ceramic	235-7195P2
C235		Not used
C236	10pF, Mica	235-7355P401
C237	.001uF, Ceramic	235-7195P2
C238	2pF, Mica	235-7355P1
C239		Not used
C240		Not used
C241	.001uF, Ceramic	235-7195P2
C242	.02uF, Mylar	169256-48
C243	10uF/16VDCW, Electrolyt.	235-7199P4
C244	.001uF, Ceramic	235-7195P2
C245	.001uF, Ceramic	235-7195P2
C301 through C310		Not used
C311	.02uF, Mylar	169256-48
C312	33uF/6.3V, Electrolytic	235-7395P26
C313	.01uF, Mylar	235-7396P13
C314	.01uF, Mylar	235-7396P13
C315	.01uF, Mylar	235-7396P13

Circuit Symbol	Description	Part Number
Capacitor, Fixed		
C316	.001uF, Mylar	235-7396P1
C317		Not used
C318		Not used
C319		Not used
C320		Not used
C321	33uF/6.3V, Electrolytic	235-7395P26
C322	.01uF, Mylar	235-7396P13
C323	22uF/6.3V, Electrolytic	235-7395P25
C324 through C330		Not used
C331	22uF/6.3V, Electrolytic	235-7395P25
C332	33uF/6.3V, Electrolytic	235-7395P26
C333	.02uF, Mylar	169256-48
C401 thorugh C410		Not used
C411	15pF, Mica	235-7053P12
C412	330pF, Mica	235-7053P305
C413	82pF, Mica	235-7053P245
C414	100pF, Mica	235-7355P33
C415	0.02uF, Mylar	169256-48
C416	0.02uF, Mylar	169256-48
C417	0.0022uF, Mylar	235-7352P121
C418	47pF, Mica	235-7355P6
C419	0.02uF, Mylar	169256-48
C420 through C430		Not used
C431	0.02uF, Mylar	169256-48
C432	47pF, Mica	235-7355P6
C433	.02uF, Mylar	169256-48
C434	.02uF, Mylar	169256-48
C435 thrcugh C440		Not used
C441	82pF, Mica	235-7053P245
C442	.02uF, Mylar	169256-48
C443	47pF, Mica	235-7355P6
C444	.02uF, Mylar	169256-48
C445	.02uF, Mylar	169256-48
C446	15pF, Mica	235-7053P12
C447	270pF, Mica	235-7053P207
C448	68pF, Mica	235-7355P205
C449		Not used
C450		Not used
C451	.02uF, Mylar	169256-48
C452	15pF, Mica	235-7053P12
C453	.001uF, Mylar	235-7396P1
C454	.02uF, Mylar	169256-48
C455	0.5pF, Mica	587968-75
C456	22pF, Mica	235-7355P201
C457	82pF, Mica	235-7053P245
C458		Not used
C459		Not used
C460		Not used
C461	.02uF, Mylar	169256-48
C462	22pF, Mica	235-7355P201
C463	.001uF, Mylar	235-7396P1
C464	0.5pF, Mica	589968-75
C465	.02uF, Mylar	169256-48
C466 through C470		Not used
C471	47pF, Mica	235-7355P6
C472	47pF, Mica	235-7355P6
C473	0.001uF, Mylar	235-7396P1
C474	47pF, Mica	235-7355P6
C475	.001uF, Mylar	235-7396P1
C476	.02uF, Mylar	169256-48
C477	.02uF, Mylar	169256-48
C478		Not used
C479		Not used
C480		Not used
C481	15pF, Mica	235-7053P12
C482	7pF, Mica	235-7053P3
C483		Not used
C484	.001uF, Mylar	235-7396P1
C485	.02uF, Mylar	169256-48
C486	.001uF, Mylar	235-7396P1
C487	.02uF, Mylar	169256-48
C488	47uF/16VDCW, Electrolytic	235-7199P9
C489		Not used
C490		Not used
C491	.001uF, Feedthru	587968-91
C492	.001uF, Mylar	235-7396P1
C493	47uF/16VDCW, Electrolytic	235-7199P9
C494	.02uF, Mylar	169256-48
C495	56pF, Mica	235-7053P65
C496	33pF, Mica	235-7053P41
C501	.47uF/25V, Electrolytic	235-7395P74
C502	.02uF, Mylar	169256-48
C503	.001uF, Feedthru	587968-91
C504	.001uF, Feedthru	587968-91
C505	47uF/16V, Electrolytic	235-7199P6
C506	.02uF, Mylar	169256-48
C507	.001uF, Mylar	235-7396P1
C508	33pF, Mica	235-7053P41
C509	5pF, Mica	235-7053P1
C510		Not used
C511	.47uF/25V, Electrolytic	235-7395P74
C512	.02uF, Mylar	169256-48
C513	0.001uF, Mylar	235-7396P1
C514	0.001uF, Mylar	235-7396P1
C515	.02uF, Mylar	169256-48
C516	47uF/16V, Electrolytic	235-7199P6
C517	.25pF/250V, Ceramic	235-7196P62
C518	500pF, Mica	587968-79
C519	10pF, Mica	235-7355P401
C520	.001uF, Feedthru	587968-91
C521		Not used
C522	10pF, Mica	235-7355P401
C523	7pF, Mica	235-7053P3
C524	10pF, Mica	235-7355P401
C525	7pF, Mica	235-7053P3
C526	7pF, Mica	235-7053P3
C527	10pF, Mica	235-7355P401
C528		Not used
C529	10pF, Mica	235-7355P401
C530		Not used
C531	47pF, Mica	235-7355P6
C532	.001uF, Feedthru	587968-91
C601 through C610		Not used
C611	.001uF, Mylar	235-7396P1
C612	1uF/16V, Electrolytic	235-7395P46
C613	33uF/6.3V, Electrolytic	235-7395P55
C614	1uF/16V, Electrolytic	235-7395P46
C615 through C620		Not used
C621	22uF/6.3V, Electrolytic	235-7395P25
C622	100uF/16V, Electrolytic	235-7199P12
C623	10uF/16V, Electrolytic	235-7199P4
C624	10uF/16V, Electrolytic	235-7199P4
C625	.015uF, Mylar	235-7352P161
C626	.0022uF, Mylar	235-7352P121
C627	220pF, Mica	235-7355P215

Circuit Symbol	Description	Part Number
Capacitor, Fixed		
C628	.0022uF, Mylar	235-7352P121
C629	.015uF, Mylar	235-7352P161
C630	.47uF/25V, Electrolytic	235-7395P74
C701 through C710		Not used
C711	.001uF, Mylar	235-7396P1
C712 thorugh C720		Not used
C721	.001uF, Mylar	235-7396P1
C722	.02uF, Mylar	169256-48
C723	47uF/16V, Electrolytic	235-7199P9
C901	500pF, Ceramic	587968-78
C902	0.02uF, Mylar	169256-48
C903	.001uF, Mylar	235-7396P1
C904	2200uF/16V, Electrolytic	169256-46
C905	.001uF, Mylar	235-7396P1
C906	.001uF, Mylar	235-7396P1
C907	.001uF, Mylar	235-7396P1
C908	.001uF, Mylar	235-7396P1
Filter		
FL-1		587968-92
Connector		
J1	Antenna MR-1	169256-51
J2	Earphone Jack, SJ-296	169256-55
Coil		
L101 through L110		Not used
L111	150M Rec	587968-34
L112	150M Rec	587968-35
L113	150M Rec	587968-37
L114 through L120		Not used
L121	150M Rec	587968-36
L122	16.9M Rec	587968-41
L123 through L140		Not used
L141	16.9M Rec	587968-42
L142 through L150		Not used
L151	455K Rec	587968-43
L152 through L170		Not used
L171	455K Rec	587968-44
L172	455K Rec	587968-45
L201		169256-34
L202		169256-34
L203		169256-34
L204		169256-34
L205		169256-34
L206		169256-34
L207		169256-34
L208		169256-34
L209		169256-34
L210		169256-34
L211		169256-34
L212		169256-34
L213		169256-34
L214		169256-34
L215	48M Rec	587968-38
L216 through L220		Not used
L221	140M Rec	587968-39
L222 through L230		Not used
L231	140M Rec	587968-40
L232	140M Rec	587968-39
L233	140M Rec	587968-39
L301 through L310		Not used
L311	10 MH	169256-38
L401 through L410		Not used
L411	47uH	587968-65
L412	TR 6.5M	587968-46
L413 through L430		Not used
L431	TR 6.5M	587968-47
L432 through L440		Not used
L441	TR 19.5M	587968-48
L442	TR 19.5M	587968-49
L443 through L450		Not used
L451	TR 39M	587968-50
L452	TR 39M	587968-51
L453 through L460		Not used
L461	TR 78M	587968-52
L462	TR 78M	587968-53
L463 through L471		Not used
L472		169256-26
L473	10uH	587968-62
L474 through L481		Not used
L482		169256-31
L483		169256-26
L484		Not used
L485		169256-31
L486 through L490		Not used
L491		169256-24
L501		169256-106
L502		169256-24
L503		169256-27
L504		169256-32
L505 through L510		Not used
L511		169256-106
L512		169256-35
L513		169256-25
L514		Not used
L515		169256-28
L516		169256-29
L517		169256-30

RAY-48A PARTS LIST

Circuit Symbol	Description
Coil	
L601 through L620	
L621	
L901	
L902	Heat
Crystals	
Y101 through Y160	
Y161	16.445 M
Y201	46.4666MHZ,R06
Y202	46.6333MHZ,R16
Y203	46.7333MHZ,R22A
Y204	48.3333MHZ,R26
Y205	48.3666MHZ,R28
Y206	46.5083MHZ,R68
Y207 through Y212	
Y213	48.5500MHZ,WX1
Diode	
D101 through D140	
D141	1S1588
D142 through D170	
D171	1N60
D172	1N60
D201	1S1588
D202	1S1588
D203	1S1588
D204 through D240	
D241	Zenner WZ081
D301 through D330	
D331	1N60
D332	1N60
D401 through D410	
D411	1S353/1S2689
D412	Zenner WZ081
D601 through D620	
D621	1S1588
D622	1S1588
D623	1S1588
D701 through D720	
D721	1S1588
D723	Zenner 02Z9.1A
D901	v06B
D902	u05B
Resistors, Fixed Comp. Ohms	
R101 through R110	

Part Number	Circuit Symbol	Description
	R111	56K
	R112	56K
Not used	R113	82K
	R114	270
169256-23	R115	100
	R116	10
169256-33	R117	
169256-32	R118	10
	R119	
	R120	
	R121	100K
Not used	R122	150K
	R123	270
587968-93	R124	12K
	R125	100
169256-10	R126	180K
169256-11	R127	
169256-12	R128	
169256-13	R129	
169256-14	R130	
169256-15	R131	680
	R132	33K
Not used	R133	1K
	R134	4.7K
169256-22	R135	3.3K
	R136	
	R137	220
Not used	R138 through R150	
169327-14	R151	33K
	R152	5.6K
Not used	R153	1K
	R154	10
169327-12	R155	100
169327-12	R156	220
	R157	
169327-14	R158	
169327-14	R159	
169327-14	R160	
	R161	1K
Not used	R162	33K
	R163	5.6K
587968-18	R164	1K
	R165	220
Not used	R166	330
	R167	
169327-12	R168	
169327-12	R169	
	R170	
Not used	R171	22C
	R172	
169256-8	R173	47K
587968-18	R174	47K
	R175	56K
Not used	R176	5.6K
	R177	220
169327-14	R178	
169327-14	R179	
169327-14	R180	
	R181	10K
Not used	R182	5.6K
	R183	33K
169327-14	R184	1K
587967-14	R185	1K
	R186	4.7K
587967-11	R187	220
587967-15	R188	2.2K
	R189	1K
	R190	
	R191	22K
Not used	R192	39K

Part Number
280-1171P136
280-1171P136
280-1171P142
280-1171P52
280-1171P37
280-1171P1
Not used
280-1171P1
Not used
Not used
280-1171P145
280-1171P151
280-1171P52
280-1171P112
280-1171P37
280-1171P155
Not used
Not used
Not used
Not used
280-1171P67
280-1171P127
280-1171P73
280-1171P97
280-1171P91
Not used
280-1171P49
Not used
280-1171P127
280-1171P100
280-1171P73
280-1171P1
280-1171P37
280-1171P49
Not used
Not used
Not used
Not used
280-1171P73
280-1171P127
280-1171P100
280-1171P73
280-1171P49
280-1171P55
Not used
Not used
Not used
Not used
280-1171P49
Not used
280-1171P133
280-1171P133
280-1171P136
280-1171P100
280-1171P49
Not used
Not used
Not used
280-1171P109
280-1171P100
280-1171P127
280-1171P73
280-1171P73
280-1171P97
280-1171P49
280-1171P85
280-1171P73
Not used
280-1171P121
280-1171P130

RAY-48A PARTS LIST

Circuit Symbol	Description
Resistors, Fixed Comp. Ohms	
R193	12K
R194	220
R195	560
R201	47K
R202	47K
R203	47K
R204	47K
R205	47K
R206	47K
R207	47K
R208	47K
R209	47K
R210	47K
R211	47K
R212	47K
R213	47K
R214	47K
R215	33K
R216	10K
R217	270
R218	
R219	100
R220	
R221	3.9K
R222	18K
R223	1K
R224	3.3K
R225	330
R226	47
R227	
R228	
R229	
R230	
R231	4.7K
R232	18K
R233	470
R234	5.6K
R235	330
R236	47
R237	
R238	
R239	
R240	
R241	1K
R242	820
R243	1K
R244	1.8K
R245	1.8K
R246	47K
R247	47K
R248	3.9K
R249	470
R301 through R310	
R311	33K
R312	6.8K
R313	470
R314	47
R315 through R320	
R321	39K
R322	6.8K
R323	470
R324	2.2K
R325 through R331	
R332	10K

RAY-48A PARTS LIST

Part Number	Circuit Symbol	Description
	R333	10K
280-1171P112	R334 through R340	
280-1171P49		
280-1171P64	P341	2.2K
585108-133	P401 through R410	
585108-133		
585108-133	R411	56K
585108-133	R412	18K
585108-133	R413	470
585108-133	R414	330
585108-133	R415	5.6K
585108-133	R416	22K
585108-133	R417	56K
585108-133	R418	100K
585108-133	R419	56K
585108-133	R420	330
585108-133	R421	
585108-133	R422	22
280-1171P127		
280-1171P103	R423 through R430	
280-1171P52		
Not used	R431	4.7K
280-1171P37	R432	22K
Not used	R433	10K
280-1171P94	R434	470
280-1171P118	R435	330
280-1171P73		
280-1171P91	R436 through R440	
280-1171P55		
280-1171P25	R441	3.9K
Not used	R442	47K
Not used	R443	470
Not used	R444	330
Not used	R445	22
280-1171P37	R446	22
280-1171P118	R447	
280-1171P61	R448	
280-1171P120	R449	
280-1171P55	R450	
280-1171P25	R451	47K
Not used	R452	3.9K
Not used	R453	47
Not used	R454	5.6K
Not used	R455	330
280-1171P73	R456	22
280-1171P70	R457	
280-1171P73	R458	
280-1171P82	R459	
280-1171P82	R460	
280-1171P133	R461	47K
280-1171P133	R462	3.9K
280-1171P94	R463	47
280-1171P61	R464	5.6K
	R465	1K
Not used	R466 through R471	
280-1171P127		
280-1171P103	R472	3.9K
280-1171P61	R473	47K
280-1171P25	R474	47
Not used	R475 through R480	
280-1171P130	R481	1K
280-1171P105	R482	1K
280-1171P61		
280-1171P55	R483 through R490	
Not used	R491	22C
	R492	3.9K
280-1171P109	R493	330
	R501	3.3
	R502	270
	R503	330

Part Number
280-1171P109
Not used
280-1171P85
Not used
280-1171P136
280-1171P118
280-1171P61
280-1171P55
280-1171P100
280-1171P121
280-1171P136
280-1171P145
280-1171P136
280-1171P55
Not used
280-1171P13
Not used
280-1171P97
280-1171P121
280-1171P109
280-1171P61
280-1171P55
Not used
280-1171P94
280-1171P133
280-1171P61
280-1171P55
280-1171P13
280-1171P13
Not used
Not used
Not used
Not used
280-1171P133
280-1171P94
280-1171P25
280-1171P100
280-1171P55
280-1171P13
Not used
Not used
Not used
Not used
280-1171P133
280-1171P61
280-1171P55
280-1171P100
280-1171P37
Not used
280-1171P94
280-1171P133
280-1171P25
Not used
280-1171P73
280-1171P73
Not used
585326-87
280-1171P22
585326-92
280-7212P19
585326-87
585326-96

Circuit Symbol	Description	Part Number
Resistors, Fixed Comp. Ohms		
R504 through R510		Not used
R511	560	280-1171P64
R512	3.3 Ohms ½W	280-7212P64
R513	330 Ohms ½W	585326-92
R601 through R610		Not used
R611	1K	280-1171P73
R612	33K	280-1171P127
R613	1.5K	280-1171P79
R614	10K	280-1171P109
R615	47	280-1171P25
R616 through R620		Not used
R621	4.7K	280-1171P97
R622	22K	280-1171P121
R623	1K	280-1171P73
R624	47K	280-1171P133
R625	47K	280-1171P133
R626	5.6K	280-1171P100
R627	4.7K	280-1171P97
R628	100	280-1171P37
R701 through R710		Not used
R711	100 Ohms 1W	169256-44
R712	220 Ohms	280-1171P49
R713 through R720		Not used
R721	270 Ohms	280-1171P52
R722	100 Ohms 1W	169256-44
R723 through R730		Not used
R731	39 Ohms ½W	585326-47
R732	1K	280-1171P73
R733	270	280-1171P52
R734	4.7K	280-1171P97
R735	470	280-1171P61
Resistor, Variable		
VR101 through VR190		Not used
VR191	Volume Control - EVHBOBS25A14	169256-39
VR301 through VR330		Not used
VR331-332	Squelch Control - KVSF10-5DMB 10KB	169256-43
VR601 through VR610		Not used
VR611	KVSF10-5DMB 5KB	169256-42
VR612 through VR620		Not used
VR621	EVHBOAS-25B14 10KB	169256-40
VR622	EVHBOAS-25B14 10KB	169256-40
VR701 through VR710		Not used
VR711	EVT-TOAA00B13 1K	169256-41
Thermistor		
TH701 through TH730		Not used
TH731	PTH60u	169256-9
Switches		
S1	Rotary	169256-57
S2	Toggle DPST - Center	169256-58
S3	Toggle SPST	169256-59
Transistor		
Q1 through Q10		Not used
Q11	MOS - FET 3SK39/3SK49	587968-12
Q12	MOS - FET 3SK39/3SK49	587968-12
Q13	2SC381	587968-5
Q14	2SC381	587968-5
Q15	2SC381	587968-5
Q16	2SC381	587968-5
Q17	TA7061	587968-16
Q18	2SC372	587968-134
Q19	AN214	169327-11
Q20		Not used
Q21	2SC381	587968-5
Q22	2SC381	587968-5
Q23	2SC381	587968-5
Q24	2SC372	587968-134
Q25 through Q30		Not used
Q31	2SC372	587968-134
Q32	2SC372	587968-134
Q33	2SC372	587968-134
Q34	2SC372	587968-134
Q35 through Q40		Not used
Q41	2SC381	587968-5
Q42		Not used
Q43	2SC381	587968-5
Q44	2SC381	587968-5
Q45	2SC784	587968-6
Q46	2SC784	587968-6
Q47	2SC387	587968-7
Q48	2SC994	169256-1
Q49	2SC998	169256-2
Q50	2SC1241A(c)	169256-3
Q51	2SC1379(c)	169256-4
Q52 through Q60		Not used
Q61	2SC372	587968-134
Q62	2SC372	587968-134
Q63 through Q70		Not used
Q71	2SD235	169256-6
Q72	2SC372	587968-134
Q73	2SA495	169256-5
Q74	2SD235	169256-6
Trimmer		
VC201	30pF, Ceramic	587968-87
VC202	30pF, Ceramic	587968-87
VC203	30pF, Ceramic	587968-87
VC204	30pF, Ceramic	587968-87
VC205	30pF, Ceramic	587968-87
VC206	30pF, Ceramic	587968-87
VC207	30pF, Ceramic	587968-87
VC208	30pF, Ceramic	587968-87
VC209	30pF, Ceramic	587968-87
VC210	30pF, Ceramic	587968-87
VC211	30pF, Ceramic	587968-87

Circuit Symbol	Description	Part Number
Trimmer		
VC212	30pF, Ceramic	587968-87
VC213	30pF, Ceramic	587968-87
VC214	30pF, Ceramic	587968-87
VC401 through VC410		Not used
VC411	10pF, Ceramic	587968-88
VC412	10pF, Ceramic	587968-88
VC413	10pF, Ceramic	587968-88
VC414	10pF, Ceramic	587968-88
VC415	10pF, Ceramic	587968-88
VC416	10pF, Ceramic	587968-88
VC417	10pF, Ceramic	587968-88
VC418	10pF, Ceramic	587968-88
VC419	10pF, Ceramic	587968-88
VC420	10pF, Ceramic	587968-88
VC421	10pF, Ceramic	587968-88
VC422	10pF, Ceramic	587968-88
VC423 through VC470		Not used
VC471	10pF, Ceramic	587968-88
VC472 through VC482		Not used
VC483	30pF, Ceramic	587968-87
VC484 through VC490		Not used
VC491	30pF, Ceramic	587968-87
VC492	30pF, Ceramic	587968-87
VC501	10pF, Ceramic	587968-88
VC502	10pF, Ceramic	587968-88
VC503 through VC511		Not used
VC512	40pF, Ceramic	169256-47
VC513	40pF, Ceramic	169256-47
Miscellaneous		
Relay	MX2P-0 12V	587968-21
Power Connector 4P		587968-22
Microphone Connector 4P jack FM-144		587967-56
Microphone 22-383-30		587967-124
Speaker	6A100 8 Ohms 0.2W	587968 27
Earphone Plug SD-059		169256-60
Crystal Holder S-D0107-2		169256-61
Crystal Holder SZ-1011P-00		169256-62
Fuse Holder S-N1101		343-7174P1
Fuse 8A		226-7176P48
Pilot Lamp RMS-14V80-150YB		169256-64
Transistor Radiator for TO-39		169256-65
Printed Circuit Board NET090 P3-2		169256-66
Printed Circuit Board NET090 P4-2		169256-67
Printed Circuit Board NET103-3		169256-68
Printed Circuit Board NET103-2		169256-69
Printed Circuit Board NET103-1		169256-70
Printed Circuit Board NET103-3A		169256-71
Microphone, Connector, 4P Plug FM-144		169256-72
Terminal for Printed Circuit Boards	59BS8806	169256-73
Hermetic Seal Terminal A102		169256-74
Transistor Spacer SJ-5		169256-75
Front Panel		169256-76
Support Plate of Overlay Panel		169256-77
Microphone Plate		169256-78
Channel Knob		169256-79
Control Knob		169256-80
Speaker Net		169256-81
Chassis		169256-82
Front Chassis		169256-83
Rear Chassis		169256-84
Cover Chassis for PA Stage		169256-85
Heat sink for 2SD235		169256-86
Heat Sink for AN214		169256-87
Heat Leader		169256-88
Speaker Bracket		169256-89
Mic. Connector Bracket		169256-90
Filter Cover		169256-91
Crystal Oven		169256-92
Filter Case		169256-93
Mic. Hook		587968-121
Cushion for Crystal		587968-120
Heat Sink		169256-96
Cabinet		169256-97
Cabinet Side Plate		169256-98
Mounting Bracket		169256-99
Clip		169256-100
Rubber Bush		169256-101
Pole for Oven Case		169256-102
Mic. Connector Spacer		169256-103
Power Cable		169256-107
Transmit Output PCB		169256-108
Receiving PCB		169256-109
Transmitting PCB		169256-110

SECTION 9

MARINE MOBILE ANTENNAS

9.1 GENERAL

The antennas and mountings described in this section were designed specifically for marine use, therefore are encased in fiberglass and specially sealed to prevent vibration and the penetration of salt atmosphere. All antennas are pretuned during manufacture and require no adjustments when being installed. The coaxial cables are RG-58/U (273-1022P1), terminated in PL-259 (276-7177P1) connectors.

The specifications and base mounting types are listed below and shown in Figure 9-1.

MODEL M68A, for pleasure craft.

3dB gain
58" long
20' cable/connector
Vertical/horizontal split ball mount.

MODEL M69, for pleasure craft.

6dB gain
8' long
20' cable/connector
Uses ratchet mount model AM18 for deck, bulkhead, or extension mounting.

MODEL M70, for pleasure craft and small commercial vessels.

9dB gain
20' long
20' cable/connector
Uses ratchet mount model AM18 for deck, bulkhead, or extension mounting.

MODEL M71A, for sailboats.

3dB gain
54' long (5/8" fiberglass waveguide)
60' cable/connector
A 2" x 3" stainless steel "L" bracket and mounting hardware for installation on an aluminum or wooden sailboat mast are included.

9.2 ANTENNA MOUNT MODEL AM18

This unit is a chrome plated, laydown mount which offers a high resistance to marine environments and has sufficient strength to support the M69 antenna. As an added feature, this mount has a quick-release handle which allows the antenna to be mounted on a slanted deck or against a bulkhead.

9.3 ANTENNA MOUNT MODEL AM-1W

This mount provides the strength and holding power necessary to withstand rough water conditions. The deluxe universal swivel base mount swings a full 90 degrees in all directions away from the cabin for laydown. The base is chrome plated brass, and the top mount is durable Delrin with a rapid lock-up and release. When using this mount with the M70 antenna, the insulator should be removed.

9.4 ANTENNA MOUNTING/INSTALLATION

Attach mount to craft in a convenient position using 1/4" hardware. If hardware extends through a panel, use large diameter flat washers under nuts (on inside). Only stainless steel or chrome plated hardware should be used.

To prolong the life of the mounting, all hardware should be encapsulated with a silicone rubber compound.

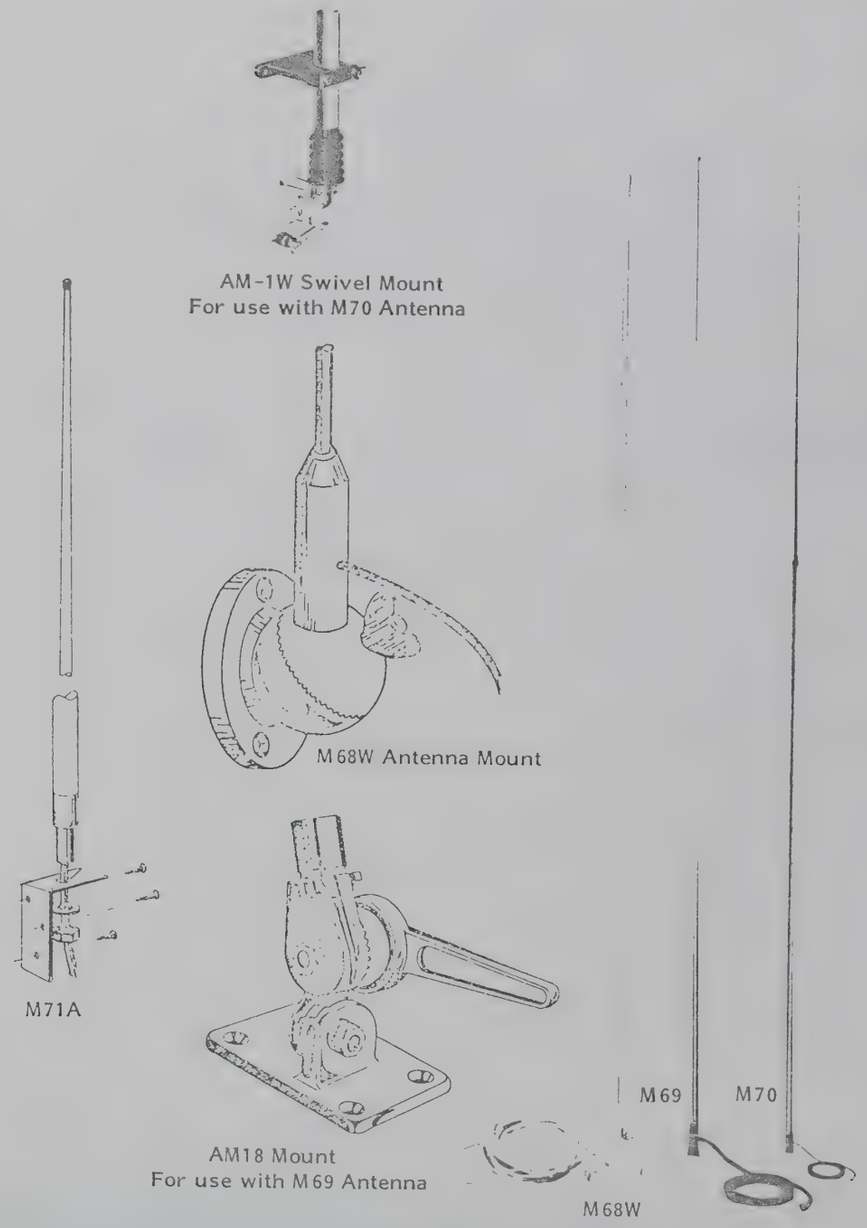


Figure 9-1 Antennas and Mount Illustration

SERVICE RECORD AND RADIO LOG

The concluding pages of this manual provide the logs necessary for proper operation and maintenance of your radiotelephone.

1. SERVICE RECORD - Enter date, type of maintenance, servicemans' signature, license number, and expiration date.

2. RADIO LOG - Enter date, time called, and call letters of the station contacted.

Service Record

INSPECTION OR SERVICE DATE	ADJUSTMENTS MADE, IF ANY	TECHNICIAN'S LICENSE NUMBER	TECHNICIAN'S LICENSE DATE	TECHNICIAN'S SIGNATURE & ADDRESS

RADIO LOG: VESSEL _____ CALL LETTERS _____

Date	Time	Call Letters & Name Of Station Or Ship Contacted	Listening Watch On	Listening Watch Off	1. Text Of All Distress Msge. 2. Remarks	Signature Of Operator

Additional log books may be obtained from your dealer.

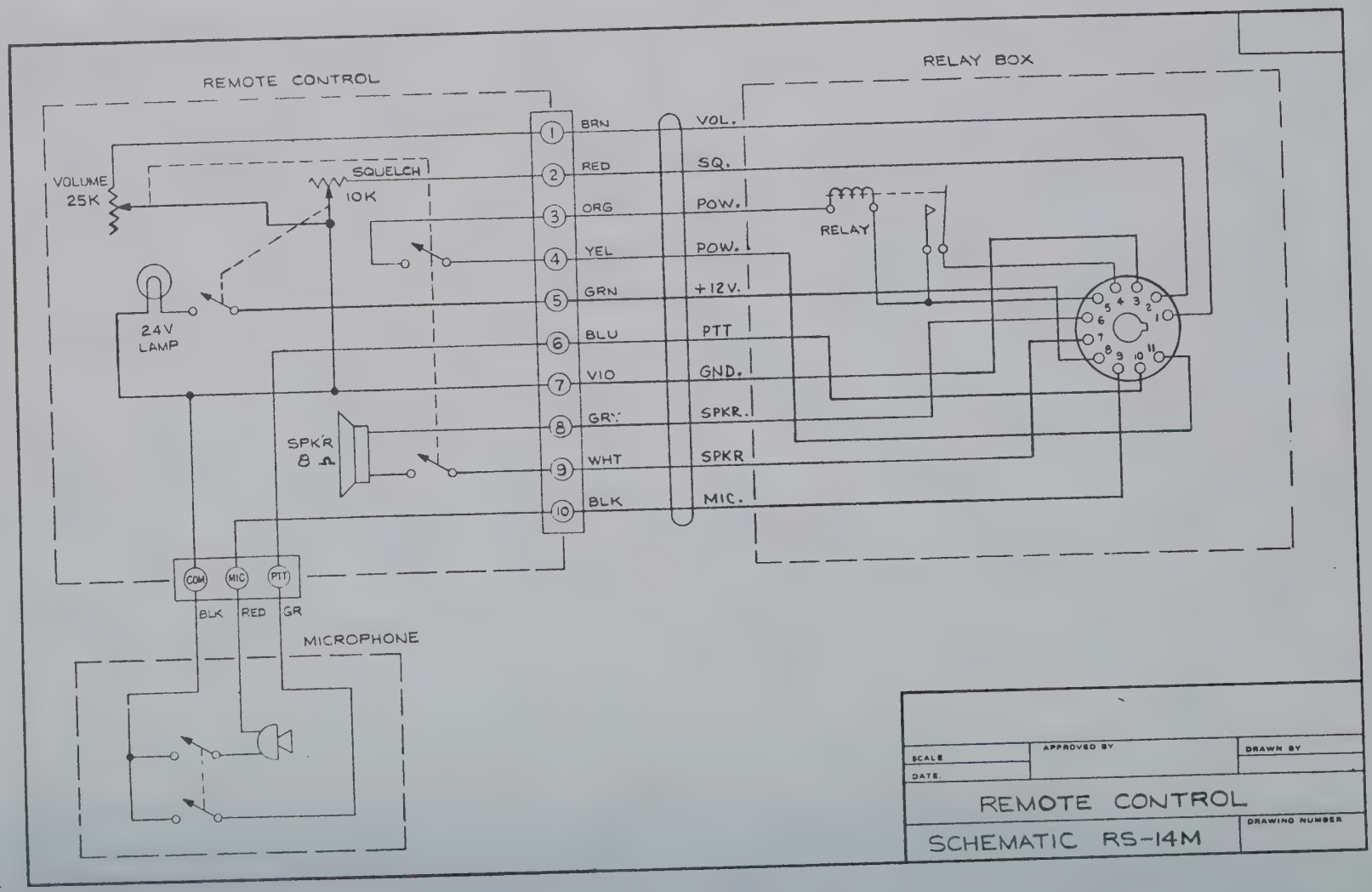
RADIO LOG VESSEL _____ CALL LETTERS _____

Date	Time	Call Letters & Name Of Station Or Ship Contacted	Listening Watch On	Listening Watch Off	1. Text Of All Distress Msge. 2. Remarks	Signature Of Operator

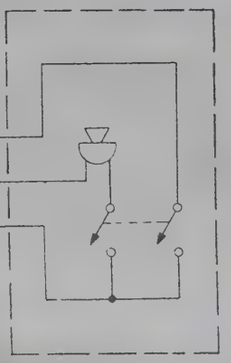
Additional log books may be obtained from your dealer.

Service Record

INSPECTION OR SERVICE DATE	ADJUSTMENTS MADE, IF ANY	TECHNICIAN'S LICENSE NUMBER	TECHNICIAN'S DATE	TECHNICIAN'S SIGNATURE & ADDRESS


REMOTE CONTROL
RELAY BOX
VOLUME
25K
SQUELCH
10K
24V
LAMP
SPKR
8 Ω
RELAY
1 BRN
2 RED
3 ORG
4 YEL
5 GRN
6 BLU
7 VIO
8 GRY
9 WHT
10 BLK
VOL.
SQ.
POW.
POW.
+12V.
PTT
GND.
SPKR.
SPKR
MIC.
COM
MIC
PTT
BLK
RED
GR
MICROPHONE
SCALE
DATE
APPROVED BY
DRAWN BY
REMOTE CONTROL
SCHEMATIC RS-14M
DRAWING NUMBER

REMOTE CONTROL
SCHEMATIC RS-14M
DRAWN BY
APPROVED BY
SCALE:
DATE:
DRAWING NUMBER



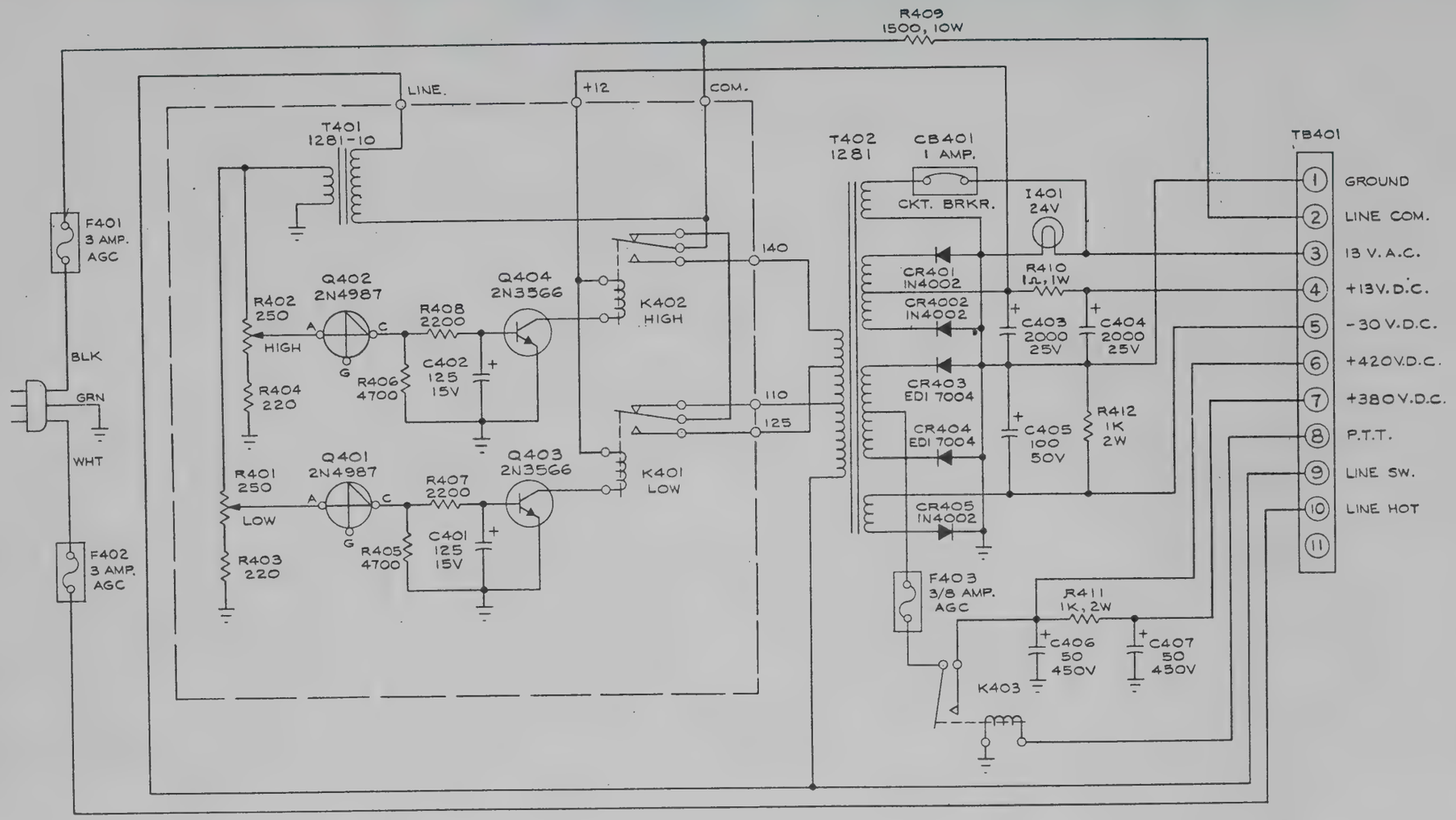
Q501 2N3055
Q502 2N3054
Q503 2N5184
Q504 2N5184
Q505 2N5184
Q506 2N5184
Q507 2N5184
Q508 2N3055
Q509 2N3055
Q510 2N3055
Q511 2N3054
Q512 2N5184
Q513 2N5184
Q514 2N5184
Q515 2N5184
Q516 2N5184
L501 1106-12
L502 1106-12
CR501 IN3208
CR502 6V
CR503 EDI 7004
CR504 EDI 7004
CR505 IN4002
CR506
CR507 IN3208
CR508 6V
F501 10 AMP. SLO-BLO
F502 10 AMP. SLO-BLO
F503 3/8 AMP. AGC
CB501 1 AMP. CKT. BRKR.
K501
T501 1249-28
TB501
TB502
R501 2200
R502 10K
R503 2200
R504 10K
R506 2200
R507 10K
R508 10K
R509 4700
R510 5K
R511 220 2W
R512 10 1W
R513 2200 2W
R514 2200
R515 10K
R516 2200
R517 10K
R518 2200
R519 10K
R520 10K
R521 5K
R522 150, 10W
R523 1K, 2W
C501 0.1
C502 1000 25V
C503A 10 450V
C503B 10 450V
C504 50 + 50V
C505 500 50V
C506 500 50V
C507 0.1
C508 1000 25V
20V. TO 50V.D.C. INPUT
BLK
WHT
GRY
VIO
BLU
GRN
YEL
ORG
RED
BRN
PW. HOT
PW. SW.
PW. RY.
+38OV
+42OV
BIAS -30V
REC. +13V
FIL. +13V
PW. COM.
GROUND

NOTE:
UNLESS OTHERWISE SPECIFIED, ALL CAPACITORS ARE IN MICROFARADS & ALL RESISTORS ARE IN OHMS, 1/2 WATT.

KONEL CORPORATION
271 HARBOR WAY SO. SAN FRANCISCO, CALIF.

SCALE	REVISIONS	BY	DATE
DATE 2-18-70			
DR'N CKD			
APV'D.			

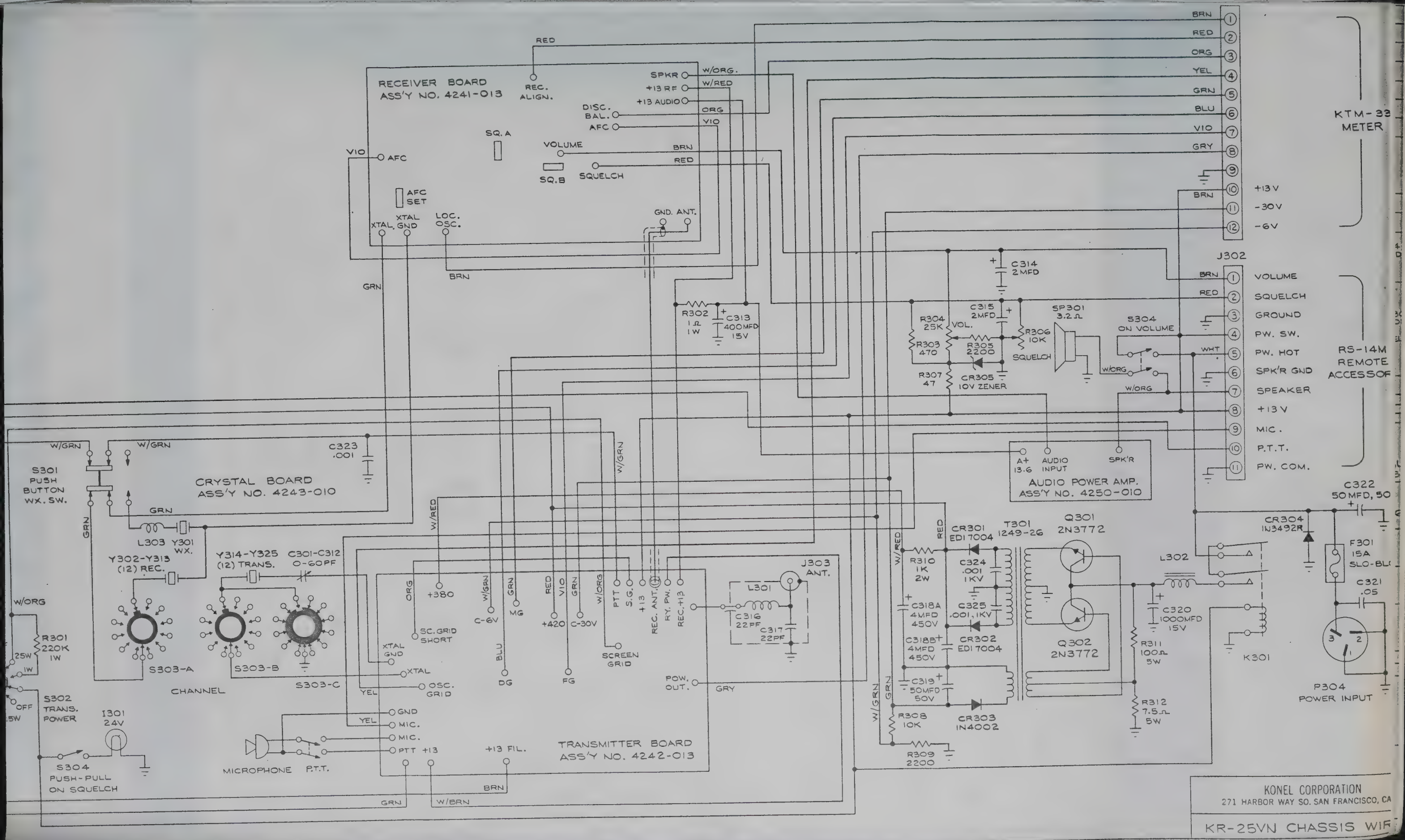
TITLE: 20-50V. P.S. SCHEMATIC
NO. K-25/34V

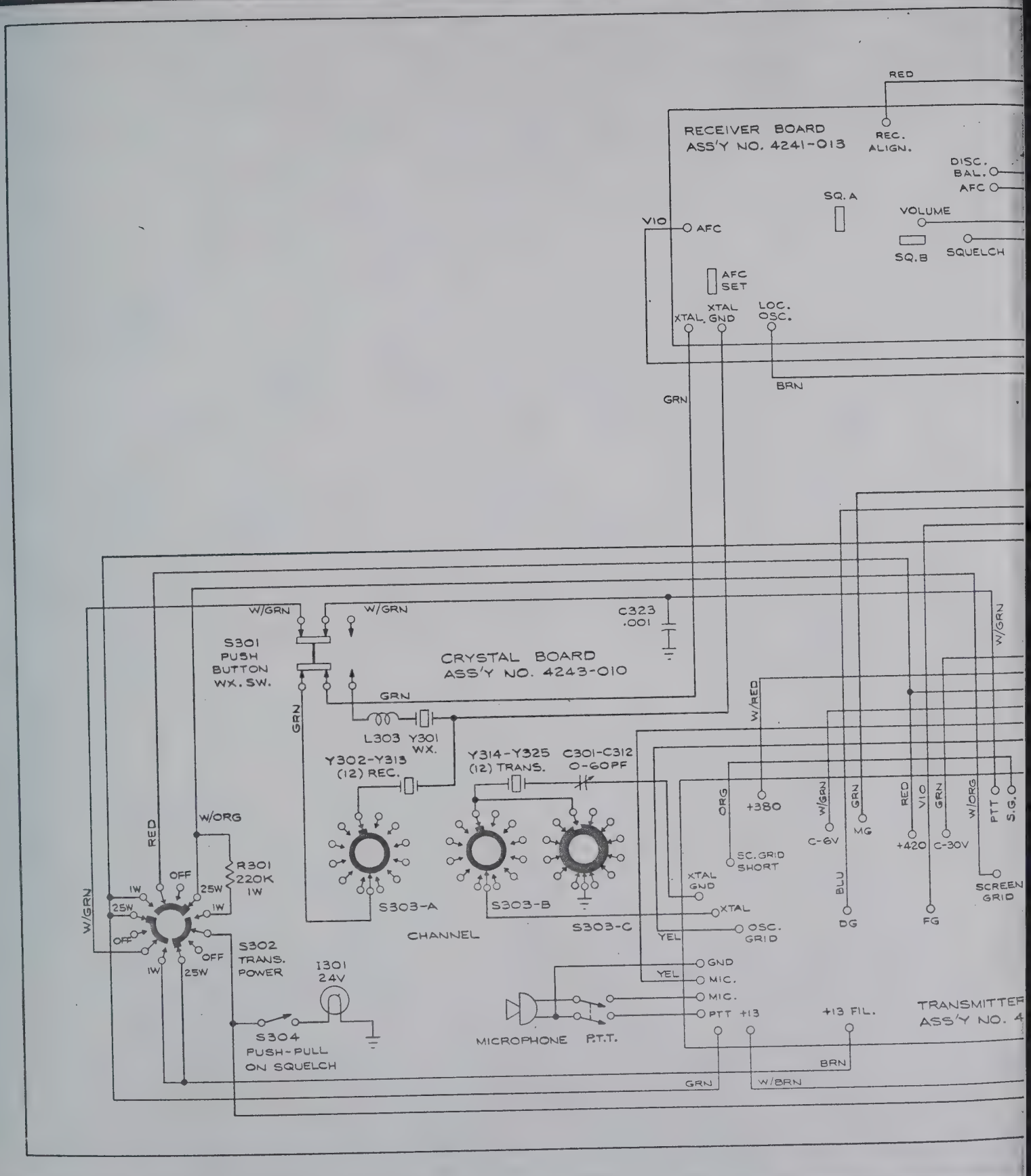


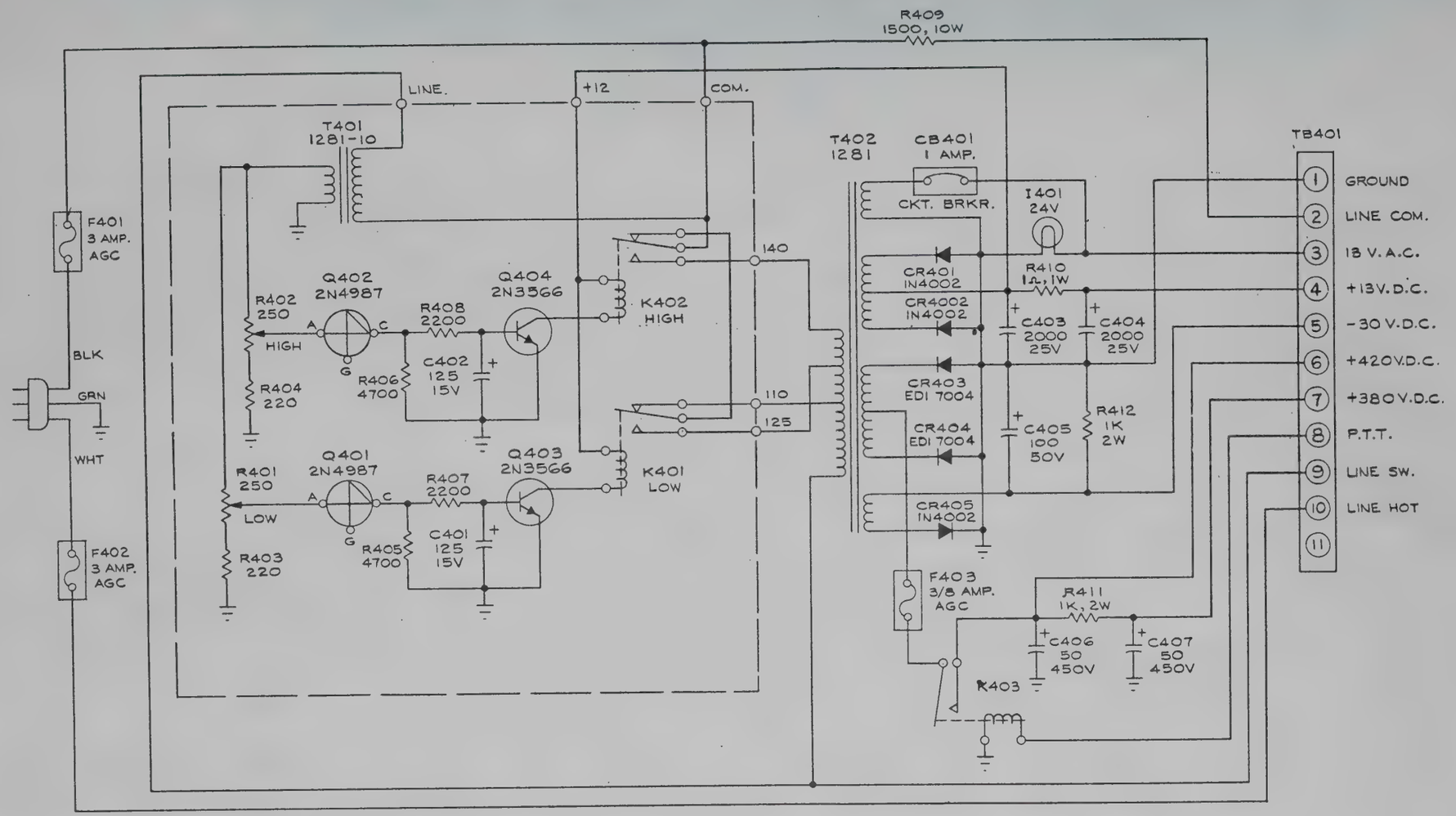
KONEL CORPORATION
271 HARBOR WAY SO. SAN FRANCISCO, CALIF.

SCALE	REVISIONS	BY	DATE
DATE 2-18-70			
DR'N. CKD.			
APV'D.			

TITLE: 100-150 V.A.C. P.S. SCHEMATIC
NO.: K-25/115V


RECEIVER BOARD
ASS'Y NO. 4241-013
REC. ALIGN.
SPKR
+13 RF
+13 AUDIO
DISC. BAL.
AFC
SQ. A
SQ. B
VOLUME
SQUELCH
AFC SET
XTAL.
XTAL GND
LOC. OSC.
GND. ANT.
RED
W/ORG.
W/RED
ORG
YIO
BRN
GRN
BRN
RED
ORG
YEL
GRN
BLU
VIO
GRY
+13 V
-30V
-6V
KTM-33 METER
J302
VOLUME
SQUELCH
GROUND
PW. SW.
PW. HOT
SPK'R GND
SPEAKER
+13 V
MIC.
P.T.T.
PW. COM.
RS-14M REMOTE ACCESSOR
R302 1Ω 1W
C313 400MFD 15V
C314 2MFD
C315 2MFD
R304 25K VOL.
R303 470
R305 2200
R306 10K SQUELCH
R307 47
CR305 10V ZENER
SP301 3.2Ω
S304 ON VOLUME
W/ORG
W/ORG
A+ 13.6
AUDIO INPUT
SPK'R
AUDIO POWER AMP.
ASS'Y NO. 4250-010
C322 50MFD, 50
CR304 1N3492R
F301 15A SLO-BL
C321 .05
P304 POWER INPUT
S301 PUSH BUTTON WX. SW.
CRYSTAL BOARD
ASS'Y NO. 4243-010
C323 .001
W/GRN
W/GRN
GRN
GRN
L303 Y301 WX.
Y302-Y313 (12) REC.
Y314-Y325 (12) TRANS.
C301-C312 0-60PF
W/RED
W/GRN
W/ORG
R301 220K 1W
25W 1W
OFF 5W
S302 TRANS. POWER
I301 24V
S304 PUSH-PULL ON SQUELCH
S303-A
S303-B
S303-C
CHANNEL
ORG
+380
SC. GRID SHORT
W/GRN
C-6V
GRN
MG
RED
VIO
+420
GRN
C-30V
W/ORG
PTT
S.G.
+13
REC. ANT.
RY. PW.
REC. +13
SCREEN GRID
XTAL GND
XTAL
OSC. GRID
YEL
BLU
DG
FG
POW. OUT.
GRY
L301
J303 ANT.
C316 22PF
C317 22PF
GND
MIC.
MIC.
PTT +13
+13 FIL.
MICROPHONE
P.T.T.
GRN
W/BRN
BRN
TRANSMITTER BOARD
ASS'Y NO. 4242-013
W/RED
RED
CR301 EDI 7004
T301 1249-26
Q301 2N3772
L302
R310 1K 2W
C318A 4MFD 450V
C318B 4MFD 450V
C324 .001 1KV
C325 .001, 1KV
CR302 EDI 7004
C319 50MFD 50V
CR303 1N4002
Q302 2N3772
C320 1000MFD 15V
R311 100Ω 5W
R312 7.5Ω 5W
K301
W/GRN
R308 10K
R309 2200
W/GRN
RED
WHT
BRN
BRN
GRN
W/GRN
W/ORG
W/ORG
W/RED
W/GRN
W/GRN
W/GRN


RECEIVER BOARD
ASS'Y NO. 4241-013
RED
REC. ALIGN.
DISC. BAL.
AFC
SQ. A
VOLUME
VIO
AFC
SQ. B
SQUELCH
AFC SET
XTAL. GND
LOC. OSC.
BRN
GRN
CRYSTAL BOARD
ASS'Y NO. 4243-010
W/GRN
W/GRN
C323 .001
S301 PUSH BUTTON WX. SW.
GRN
GRN
L303 Y301 WX.
Y302-Y313 (12) REC.
Y314-Y325 (12) TRANS.
C301-C312 0-60PF
W/RED
W/GRN
W/ORG
RED
R301 220K 1W
OFF
1W
25W
S303-A
S303-B
S303-C
CHANNEL
S302 TRANS. POWER
I301 24V
S304 PUSH-PULL ON SQUELCH
ORG
+380
SC. GRID SHORT
W/GRN
C-6V
GRN
MG
RED
+420
VIO
C-30V
GRN
W/ORG
PTT
S.G.O
SCREEN GRID
XTAL GND
XTAL
OSC. GRID
BLU
DG
FG
YEL
GND
MIC.
MIC.
PTT
+13
+13 FIL.
MICROPHONE
P.T.T.
BRN
GRN
W/BRN
TRANSMITTER
ASS'Y NO. 4



KONEL CORPORATION			
271 HARBOR WAY SO. SAN FRANCISCO, CALIF.			
SCALE	REVISIONS	BY	DATE
DATE 2-18-70			
DR'N CKD.			
APVD.			
TITLE: 100-150 V.A.C. P.S. SCHEMATIC		NO. K-25/115V	

CHARLES BRUNING CO. — FIVE HUNDRED

RECEIVER BOARD
ASS'Y NO. 4241-013

REC. ALIGN.

SPKR
+13 RF
+13 AUDIO
DISC. BAL.
AFC
VOLUME
SQUELCH
SQ. A
SQ. B
AFC SET
XTAL
XTAL. GND
LOC. OSC.
GND. ANT.

RED
W/ORG.
W/RED
ORG
VIO
BRN
RED
VIO
AFC
GRN
BRN

J301

BRN	1	
RED	2	
ORG	3	
YEL	4	
GRN	5	
BLU	6	
VIO	7	
GRY	8	
	9	
BRN	10	+13 V
	11	-30 V
	12	-6 V

KTM-33 METER

J302

BRN	1	VOLUME
RED	2	SQUELCH
	3	GROUND
	4	PW. SW.
WHT	5	PW. HOT
	6	SPK'R GND
	7	SPEAKER
	8	+13 V
	9	MIC.
	10	P.T.T.
	11	PW. COM.

RS-14M REMOTE ACCESSORY

R302 1Ω 1W
C313 400MFD 15V
C314 2MFD
C315 2MFD
R304 25K VOL.
R303 470
R305 2200
R306 10K SQUELCH
R307 47
CR305 10V ZENER
SP301 3.2Ω
S304 ON VOLUME
W/ORG
W/ORG

A+ 13.6
AUDIO INPUT
SPK'R
AUDIO POWER AMP.
ASS'Y NO. 4250-010

C322 50MFD, 50V
CR304 IN3492R
F301 15A SLO-BLO
C321 .05
P304 POWER INPUT

W/GRN
W/GRN
C323 .001
S301 PUSH BUTTON WX. SW.
GRN
GRN
L303 Y301 WX.
Y302-Y313 (12) REC.
Y314-Y325 (12) TRANS.
C301-C312 0-60PF
W/ORG
R301 220K 1W
S303-A
S303-B
S303-C
CHANNEL
S302 TRANS. POWER
I301 24V
S304 PUSH-PULL ON SQUELCH
XTAL GND
XTAL
OSC. GRID
YEL
GND
MIC.
MIC.
PTT +13
MICROPHONE P.T.T.
+13 FIL.
GRN
W/BRN
BRN

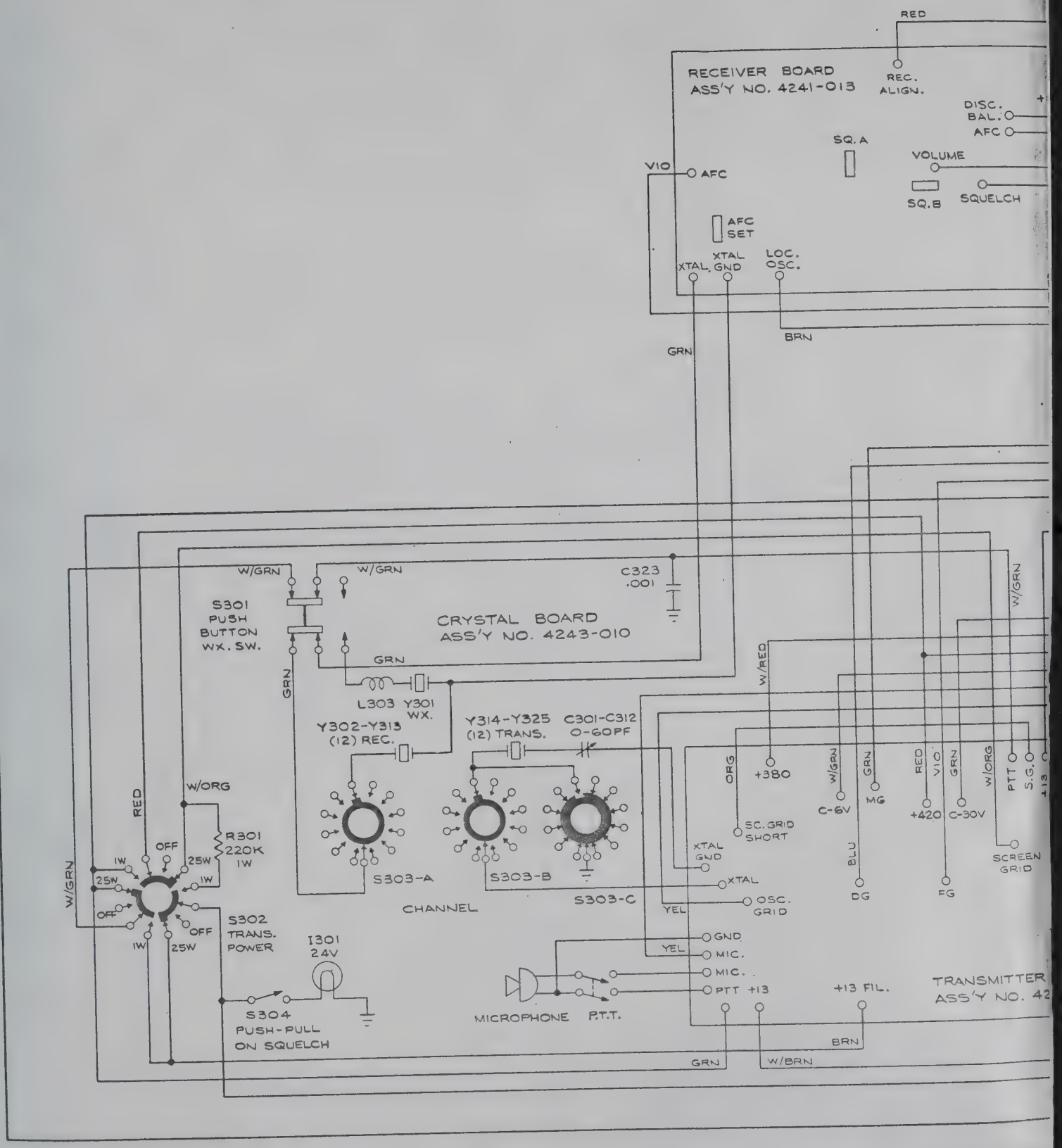
ORG +380
SC. GRID SHORT
W/GRN C-6V
GRN MG
BLU DG
RED +420
VIO C-30V
GRN FG
W/ORG SCREEN GRID
PTT
S.G.
+13
REC. ANT.
RY. PW.
REC. +13
POW. OUT.
GRY
W/GRN
W/RED

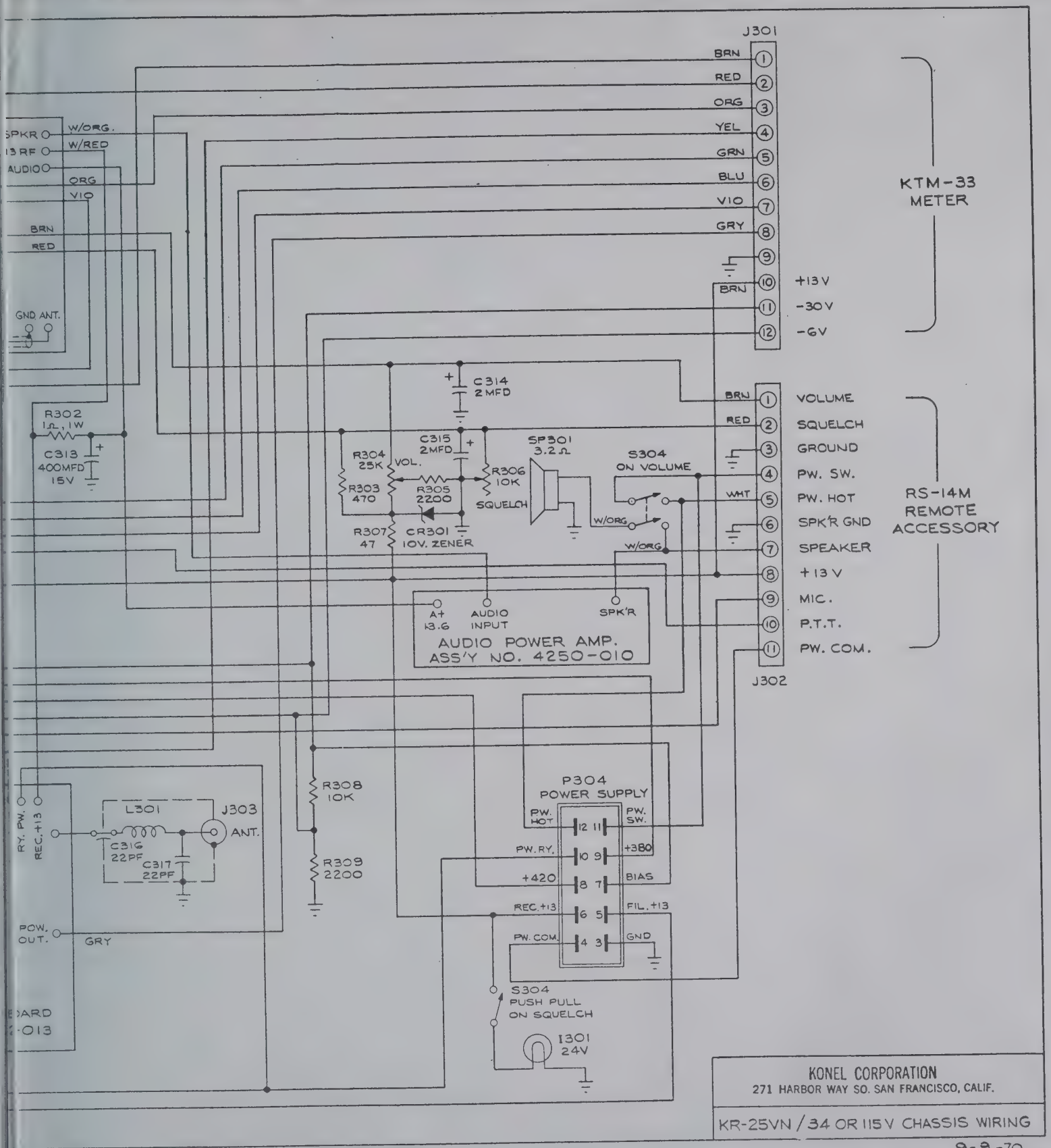
J303 ANT.
L301
C316 22PF
C317 22PF

W/RED
R310 1K 2W
C318A 4MFD 450V
C318B 4MFD 450V
C319 50MFD 50V
R308 10K
R309 2200
GRN
W/GRN
RED
CR301 EDI 7004
C324 .001 1KV
C325 .001, 1KV
CR302 EDI 7004
CR303 IN4002
T301 1249-26
Q301 2N3772
Q302 2N3772
L302
C320 1000MFD 15V
R311 100Ω 5W
R312 7.5Ω 5W
K301

KONEL CORPORATION
271 HARBOR WAY SO. SAN FRANCISCO, CAL

KR-25VN CHASSIS WIR

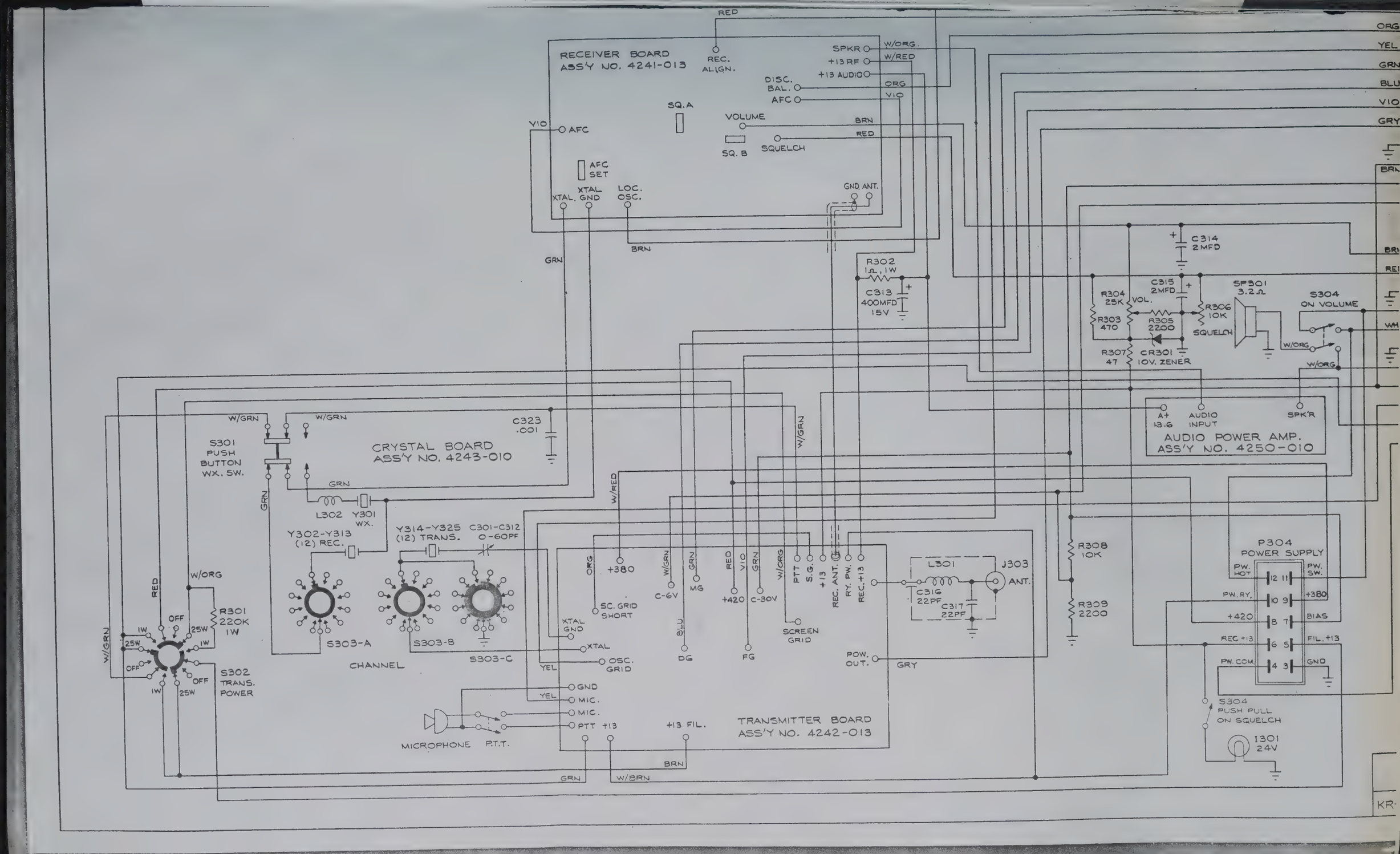

RECEIVER BOARD
ASS'Y NO. 4241-013
RED
REC. ALIGN.
DISC. BAL.
AFC
SQ. A
VOLUME
V10
AFC
SQ. B
SQUELCH
AFC SET
XTAL
XTAL GND
LOC. OSC.
BRN
GRN
CRYSTAL BOARD
ASS'Y NO. 4243-010
S301 PUSH BUTTON WX. SW.
W/GRN
C323 .001
GRN
L303 Y301 WX.
Y302-Y313 (12) REC.
Y314-Y325 (12) TRANS.
C301-C312 0-60PF
W/ORG
R301 220K 1W
OFF
1W
25W
S303-A
S303-B
S303-C
CHANNEL
S302 TRANS. POWER
I301 24V
S304 PUSH-PULL ON SQUELCH
W/RED
ORG
+380
SC. GRID SHORT
C-6V
MG
+420
C-30V
SCREEN GRID
PTT
S.G.
XTAL GND
XTAL
OSC. GRID
YEL
BLU
DG
FG
GND
MIC.
PTT
+13
+13 FIL.
MICROPHONE
P.T.T.
W/BRN
TRANSMITTER
ASS'Y NO. 42

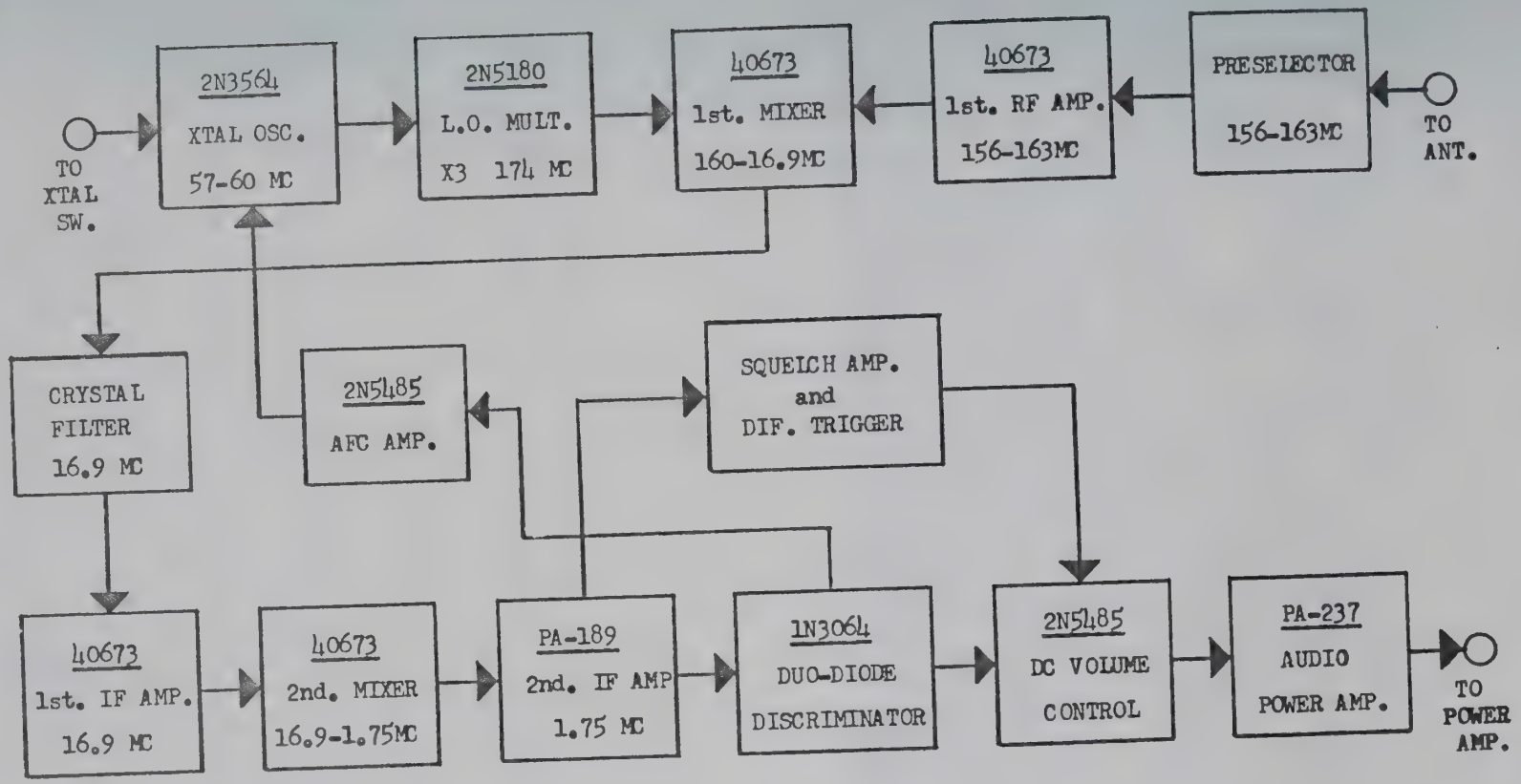


KONEL CORPORATION
271 HARBOR WAY SO. SAN FRANCISCO, CALIF.

KR-25VN / 34 OR 115V CHASSIS WIRING

9-9-70


RECEIVER BOARD
ASS'Y NO. 4241-013
REC. ALIGN.
RED
SPKR
+13 RF
+13 AUDIO
DISC. BAL.
AFC
SQ.A
SQ. B
VOLUME
SQUELCH
AFC SET
XTAL GND
LOC. OSC.
GND. ANT.
W/ORG.
W/RED
ORG
VIO
BRN
GRN
R302
1Ω, 1W
C313
400MFD
15V
C314
2MFD
C315
2MFD
R304
25K
VOL.
R303
470
R305
2200
R306
10K
SQUELCH
R307
47
CR301
10V. ZENER
SP301
3.2Ω
S304
ON VOLUME
W/ORG
A+
18.6
AUDIO INPUT
SPK'R
AUDIO POWER AMP.
ASS'Y NO. 4250-010
S301
PUSH BUTTON
WX. SW.
W/GRN
CRYSTAL BOARD
ASS'Y NO. 4243-010
C323
.001
L302
Y301
WX.
Y302-Y313
(12) REC.
Y314-Y325
(12) TRANS.
C301-C312
0-60PF
S303-A
S303-B
S303-C
CHANNEL
S302
TRANS.
POWER
R301
220K
1W
OFF
1W
25W
XTAL GND
XTAL
OSC. GRID
SC. GRID SHORT
+380
C-6V
MG
+420
C-30V
SCREEN GRID
DG
FG
PTT
S.G.
+13
REC. ANT.
RY. PW.
REC. +13
POW. OUT.
L301
C316
22PF
C317
22PF
J303
ANT.
R308
10K
R309
2200
GRY
P304
POWER SUPPLY
PW. HOT
PW. SW.
PW. RY.
+380
+420
BIAS
REC +13
FIL. +13
PW. COM
GND
S304
PUSH PULL
ON SQUELCH
I301
24V
GND
MIC.
MIC.
PTT +13
+13 FIL.
MICROPHONE
P.T.T.
TRANSMITTER BOARD
ASS'Y NO. 4242-013
YEL
BRN
GRN
W/BRN



RECEIVER BLOCK DIAGRAM

P.C. BOARD ASS'Y. #4241-04

RESISTANCE MEASUREMENTS - POWER "OFF", OHMETER POSITIVE LEAD GROUNDED.

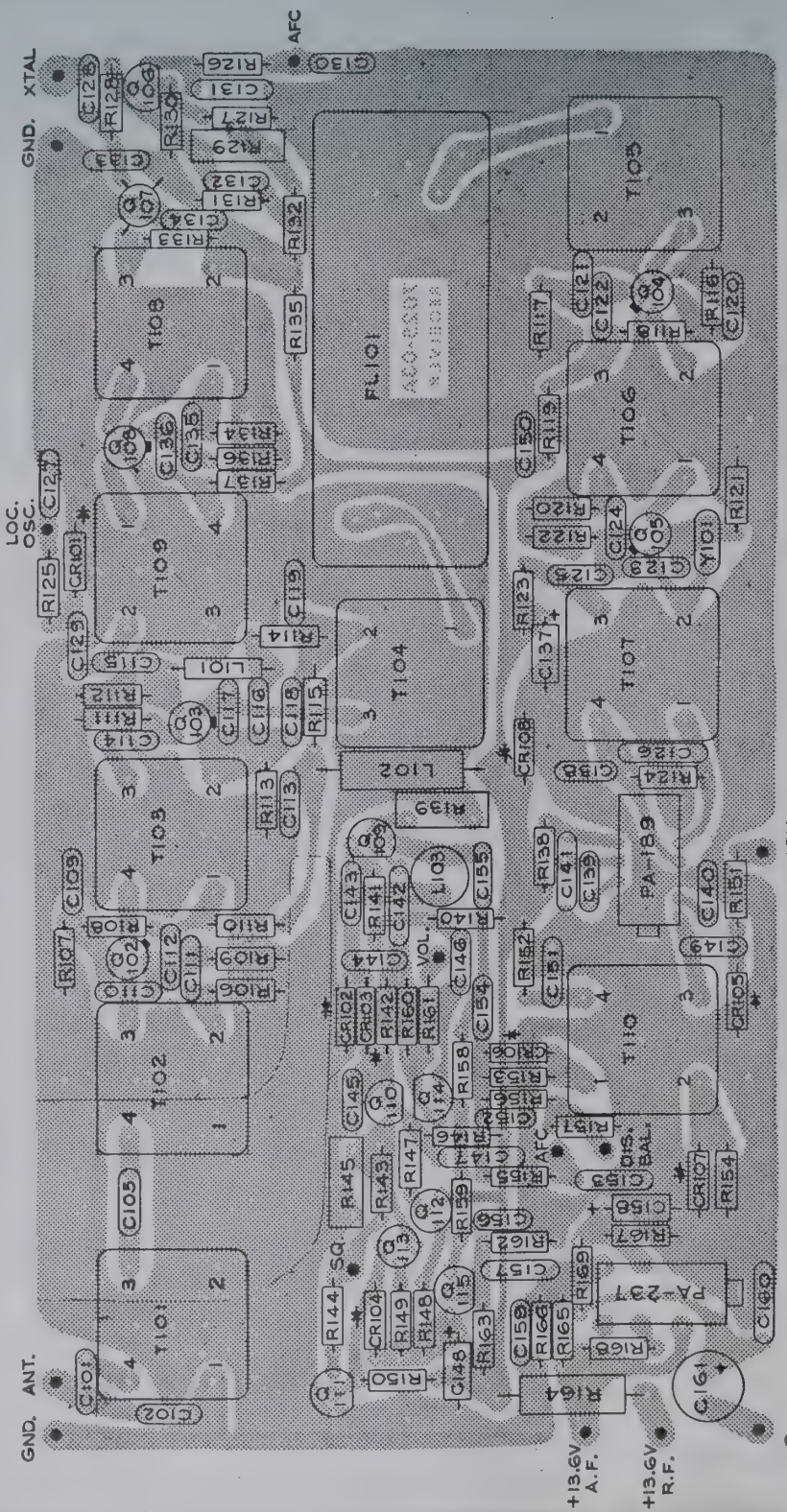
VOLTAGE MEASUREMENTS - CONTROL SETTINGS: VOLUME, FULL CLOCKWISE "ON".
SQUELCH, FULL CLOCKWISE "ON".
VOLTMETER: 20,000 OHMS PER VOLT.

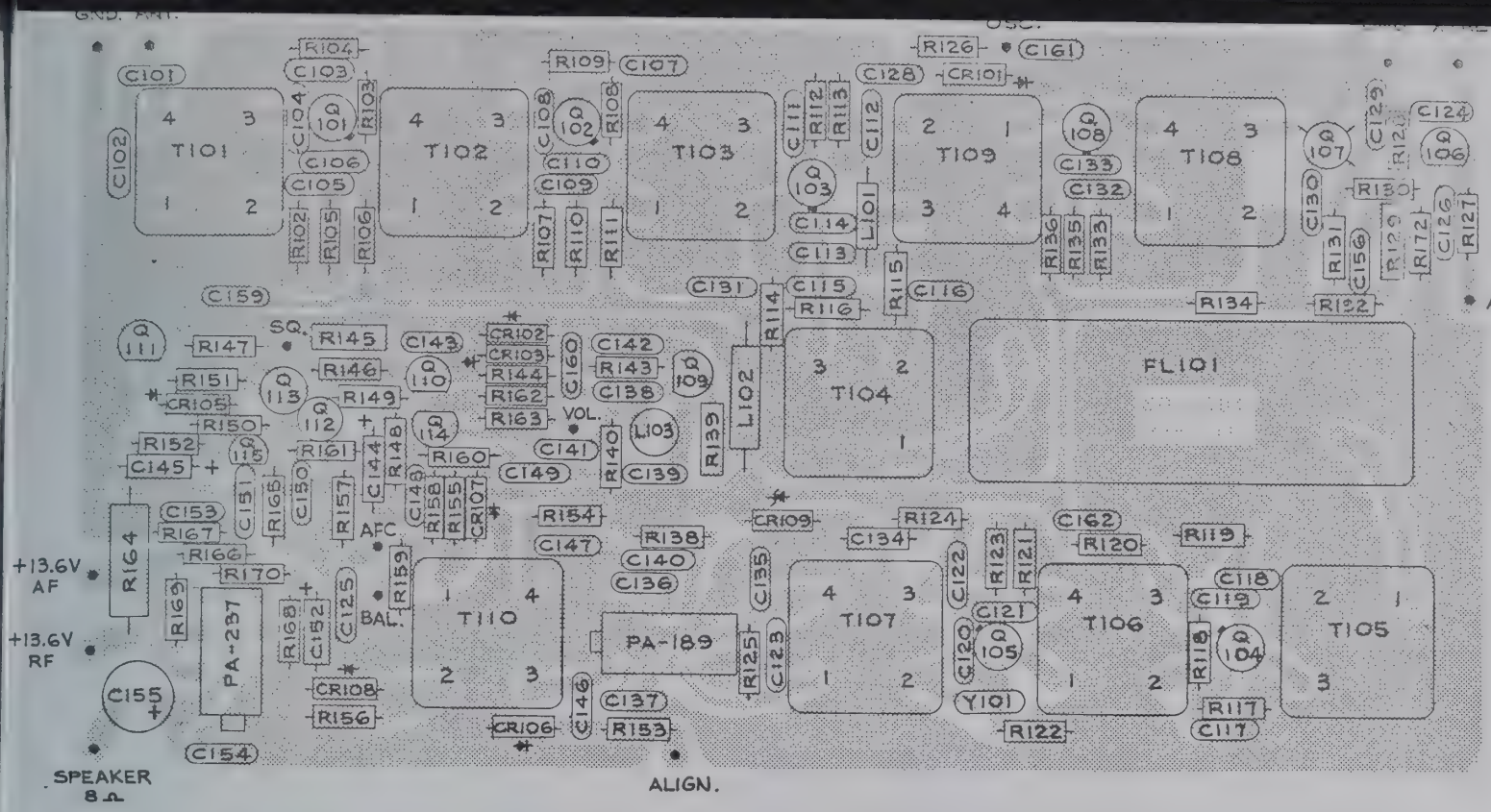
ISTOR TYPE UNCTION		BASE OR GATE #1	GATE #2	EMITTER OR SOURCE	COLLECTOR OR DRAIN
RF AMP.	E	0	2.4	1.2	9.5
	R	15K	15K	120	110
MIXER	E	0	0.3	0.2	10
	R	16K	15K	80	110
IF AMP.	E	0	2.4	1.2	9.5
	R	0	16K	120	110
MIXER	E	0	0	0.4	10
	R	2.2K	16K	120	110
5 . AMP.	E	0		1.4 (VAR.)	3
	R	2 MEG.		150 (VAR.)	270
4 OSC.	E	2.5		2.8	9
	R	1250		270	140
0 MULT.	E	0		0.8	10
	R	10K		220	140
5 CH AMP.	E	0.6 (VAR.)		0.1	8
	R	2700 (VAR.)		220	4200
5 E CONT.	E	0.2		0	0
	R	8700		0	17K
5 P.	E	0		1.6	9.5
	R	7500		11K (VAR.)	9200
5 ER	E	0.1		0.6	1.5
	R	22K		4600	25K
1 ER	E	9.5		10	0.2
	R	530		50	12K
5 CH CON.	E	1.1		0	0.6
	R	42K		0	4600
5 AMP.	E	0		0.2	0.2
	R	420K		5300	5300

ATED CIRCUITS:

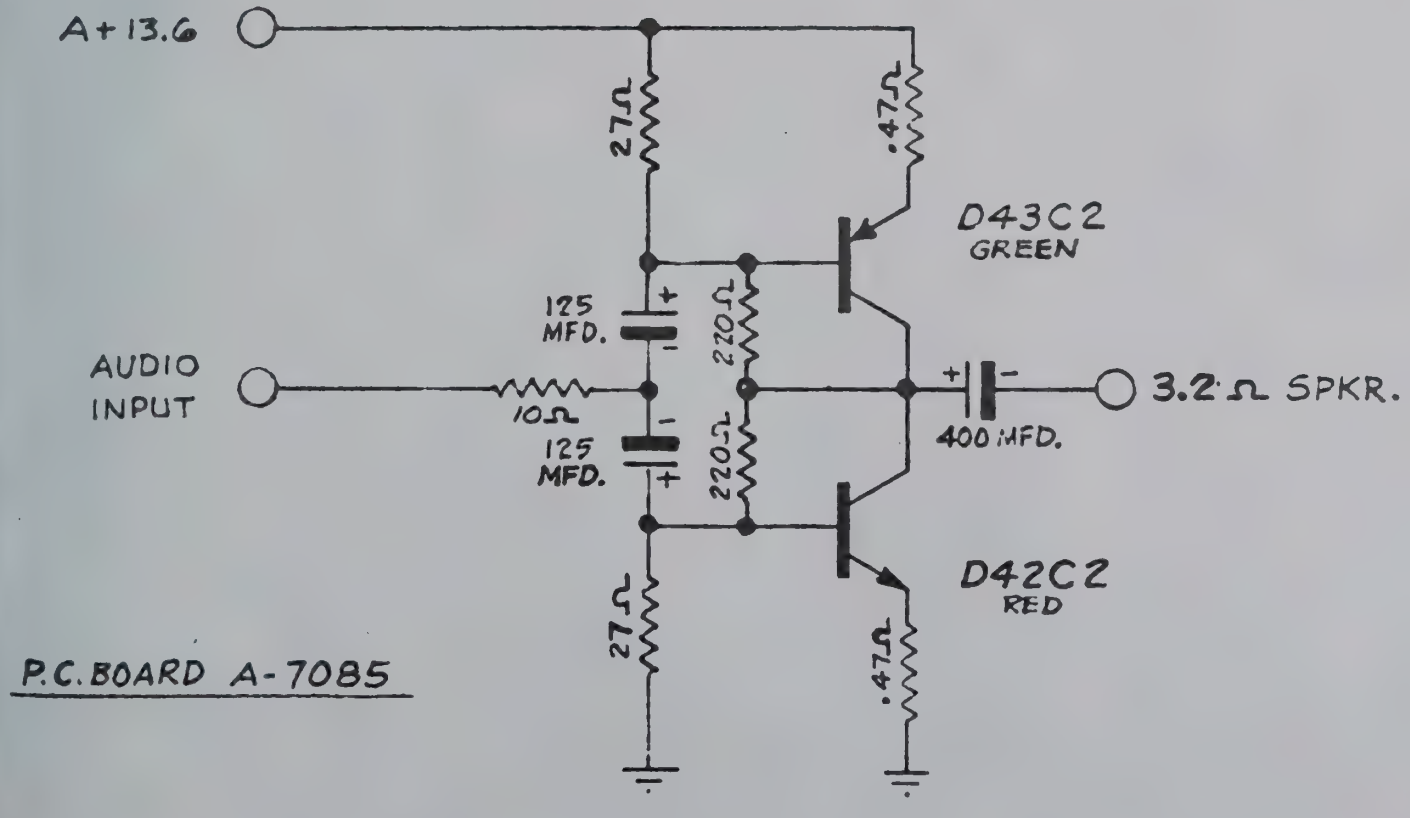
NGERS		1	2	3	4	5	6	7	8	9	10	11	12	13	14
9 F AMP.	E	0	0	8.5	7.5	5.4	0	0	10	5.4	0	2	2	0	0
	R	0	0	140	530	1500	0	0	220	675	0	370	600	0	0
7 AMP.	E	0	-	8.5	-	13.6	-	7	0	-	0	-	1.5	-	1.2
	R	∞	-	400	-	50	-	400	0	-	0	-	14K	-	14K

RECEIVER VOLTAGE AND RESISTANCE CHART

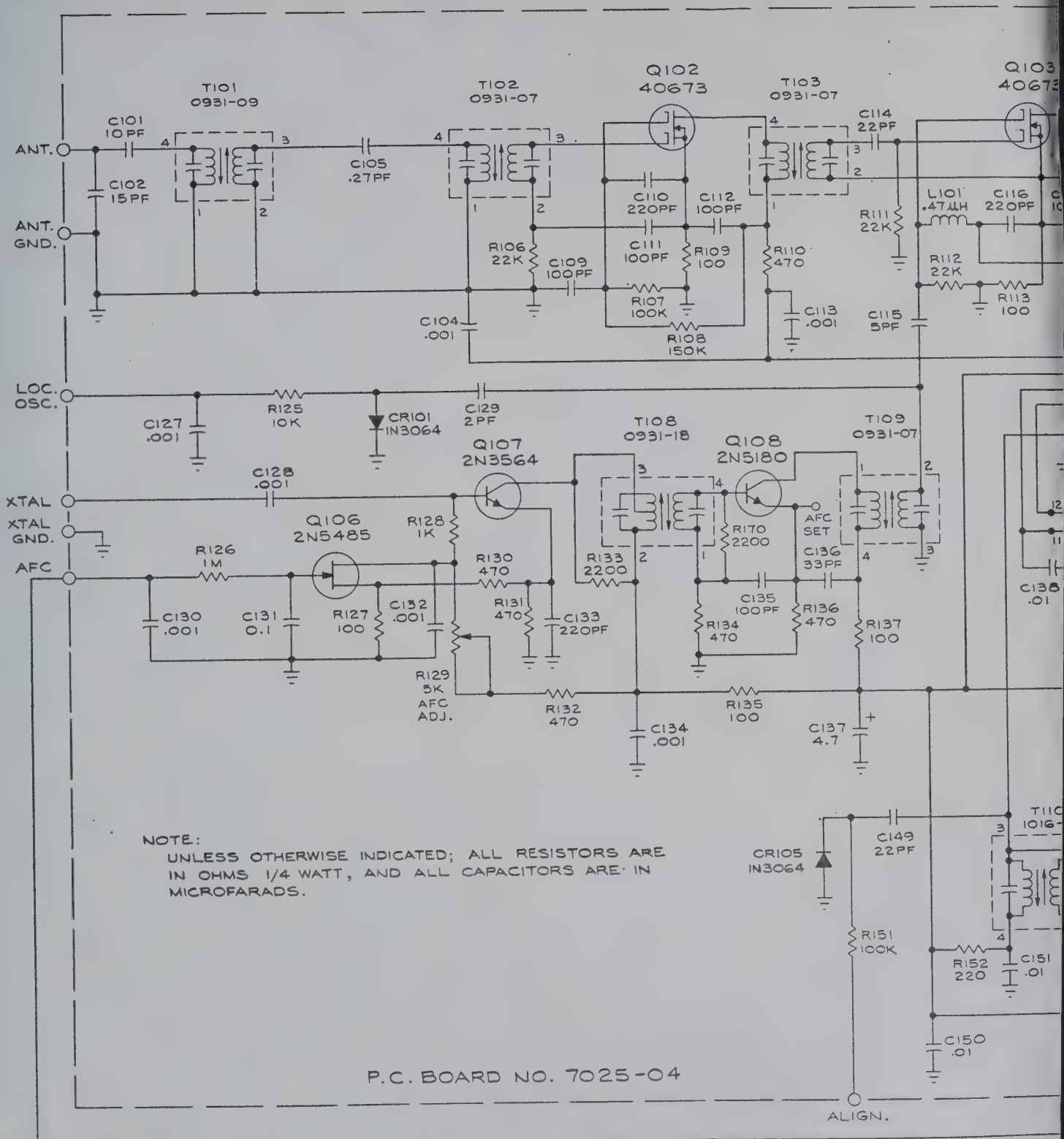




Receiver P. C. Board 7025-01/02/03

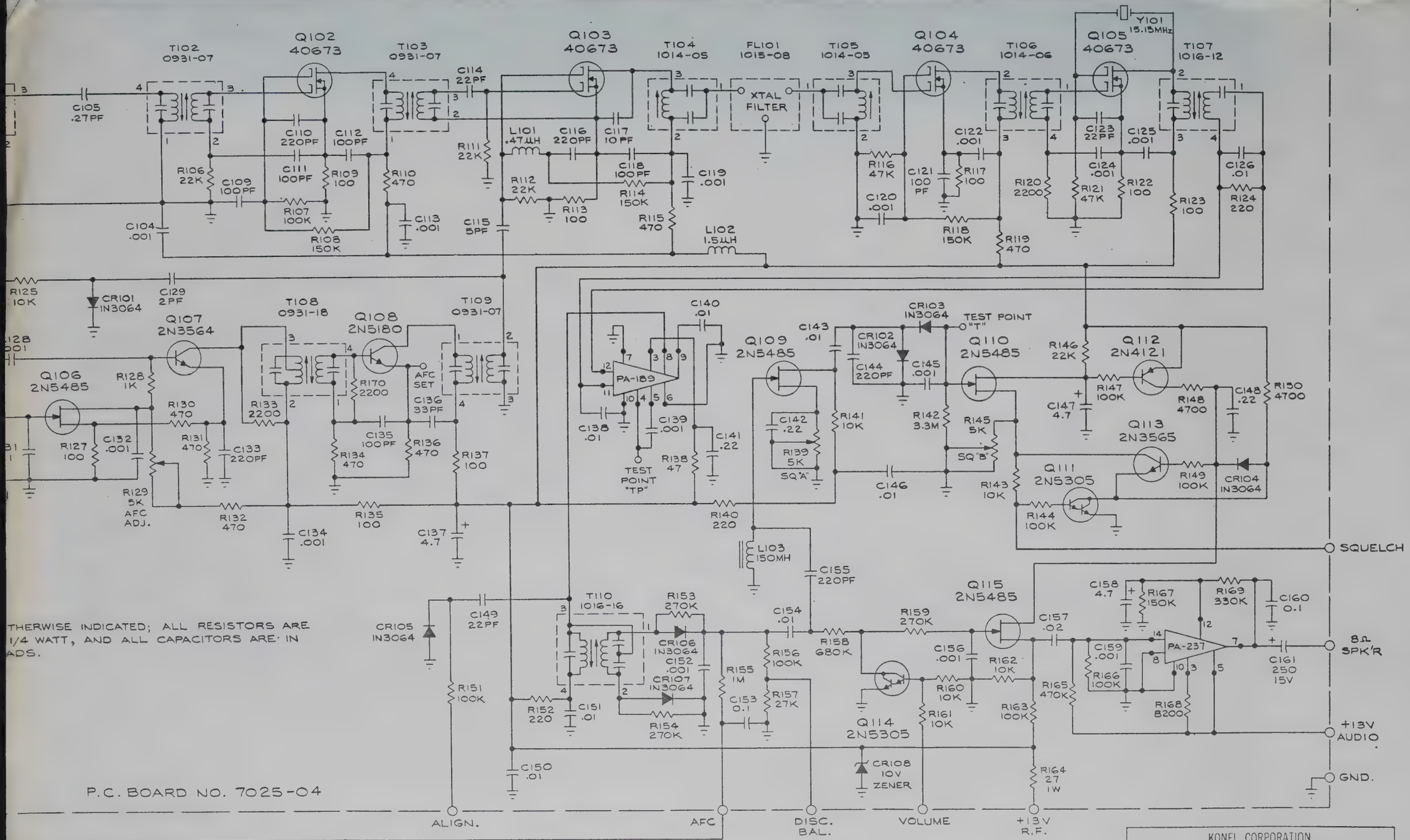


AUDIO POWER AMPLIFIER – 3 WATT



NOTE:
UNLESS OTHERWISE INDICATED; ALL RESISTORS ARE IN OHMS 1/4 WATT, AND ALL CAPACITORS ARE IN MICROFARADS.

P.C. BOARD NO. 7025-04



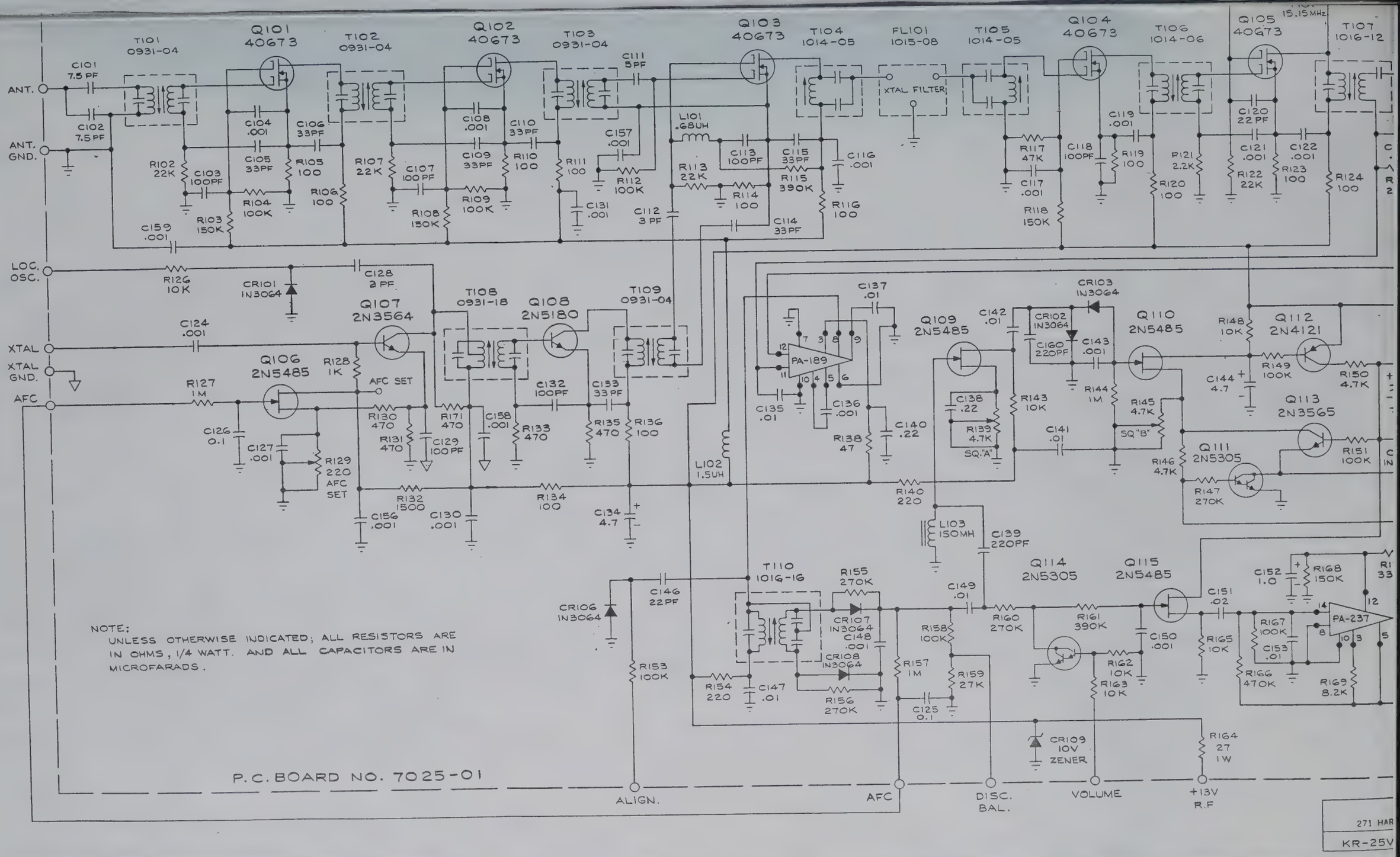
THERWISE INDICATED; ALL RESISTORS ARE 1/4 WATT, AND ALL CAPACITORS ARE IN ADS.

P.C. BOARD NO. 7025-04

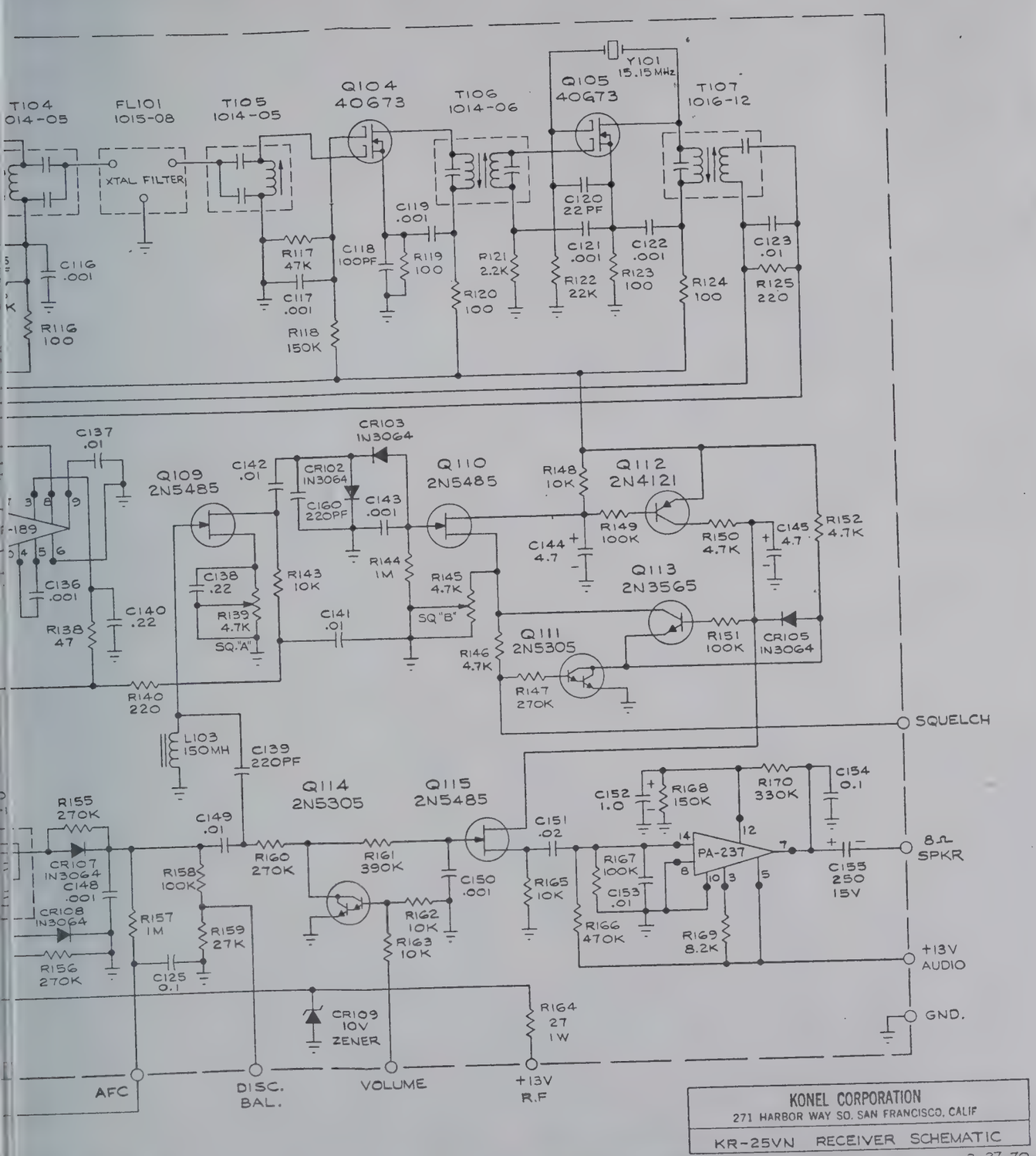
KONEL CORPORATION
271 HARBOR WAY SO. SAN FRANCISCO, CALIF.

KR-25VN RECEIVER SCHEMATIC

8-6-70



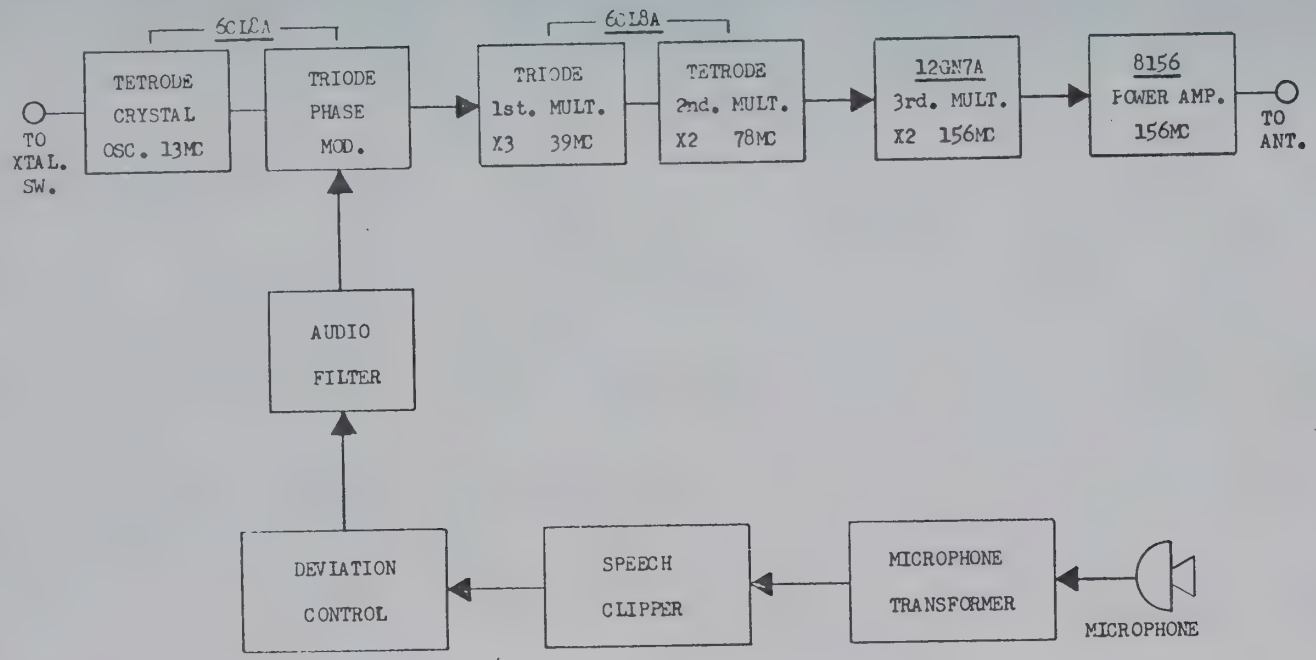
NOTE:
UNLESS OTHERWISE INDICATED; ALL RESISTORS ARE IN OHMS, 1/4 WATT. AND ALL CAPACITORS ARE IN MICROFARADS.



KONEL CORPORATION
271 HARBOR WAY SO. SAN FRANCISCO, CALIF

KR-25VN RECEIVER SCHEMATIC

3-27-70



TRANSMITTER BLOCK DIAGRAM

P.C. BOARD ASS'Y. #4242-02

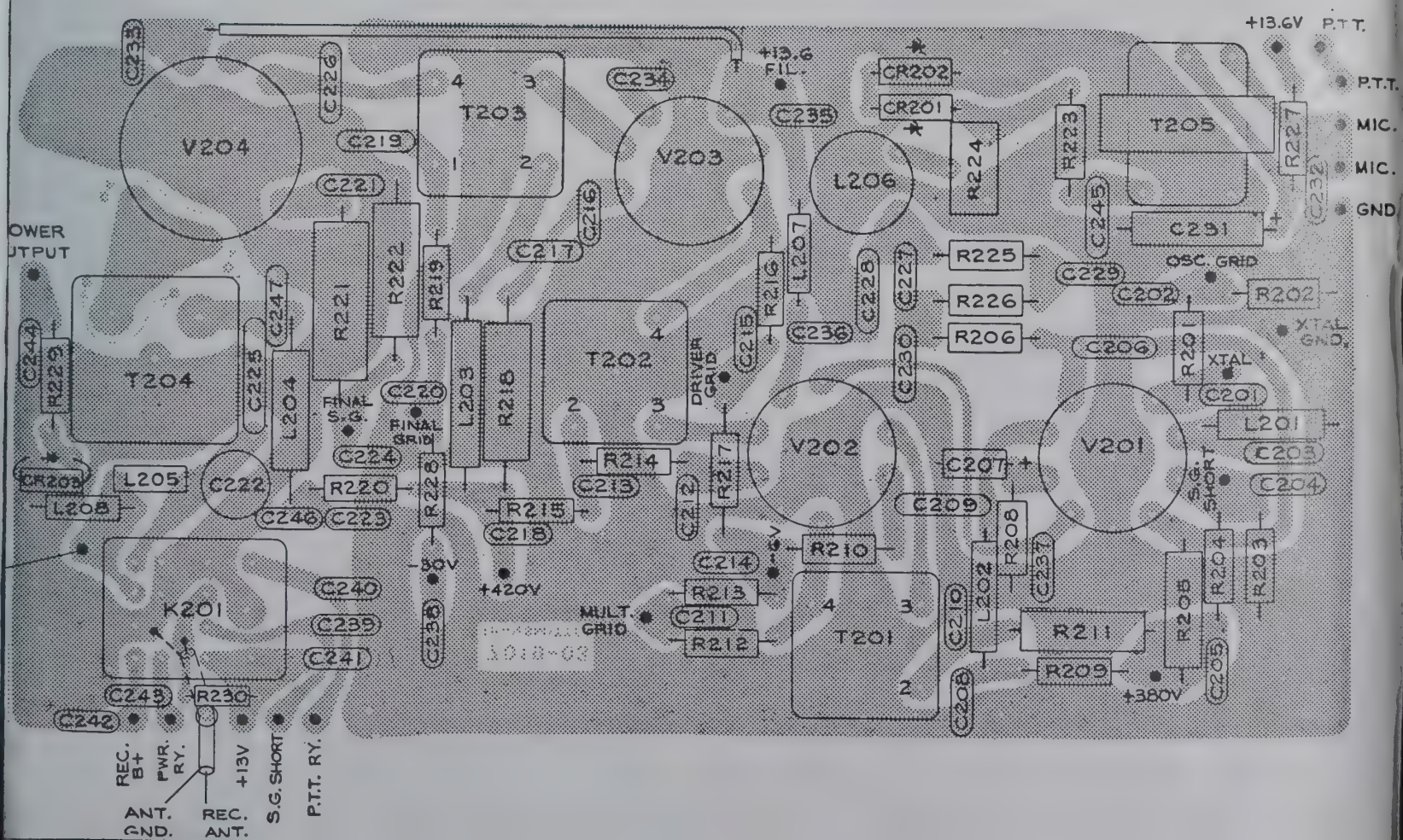
RESISTANCE MEASUREMENTS - POWER "OFF", OHMETER NEGATIVE LEAD GROUNDED.

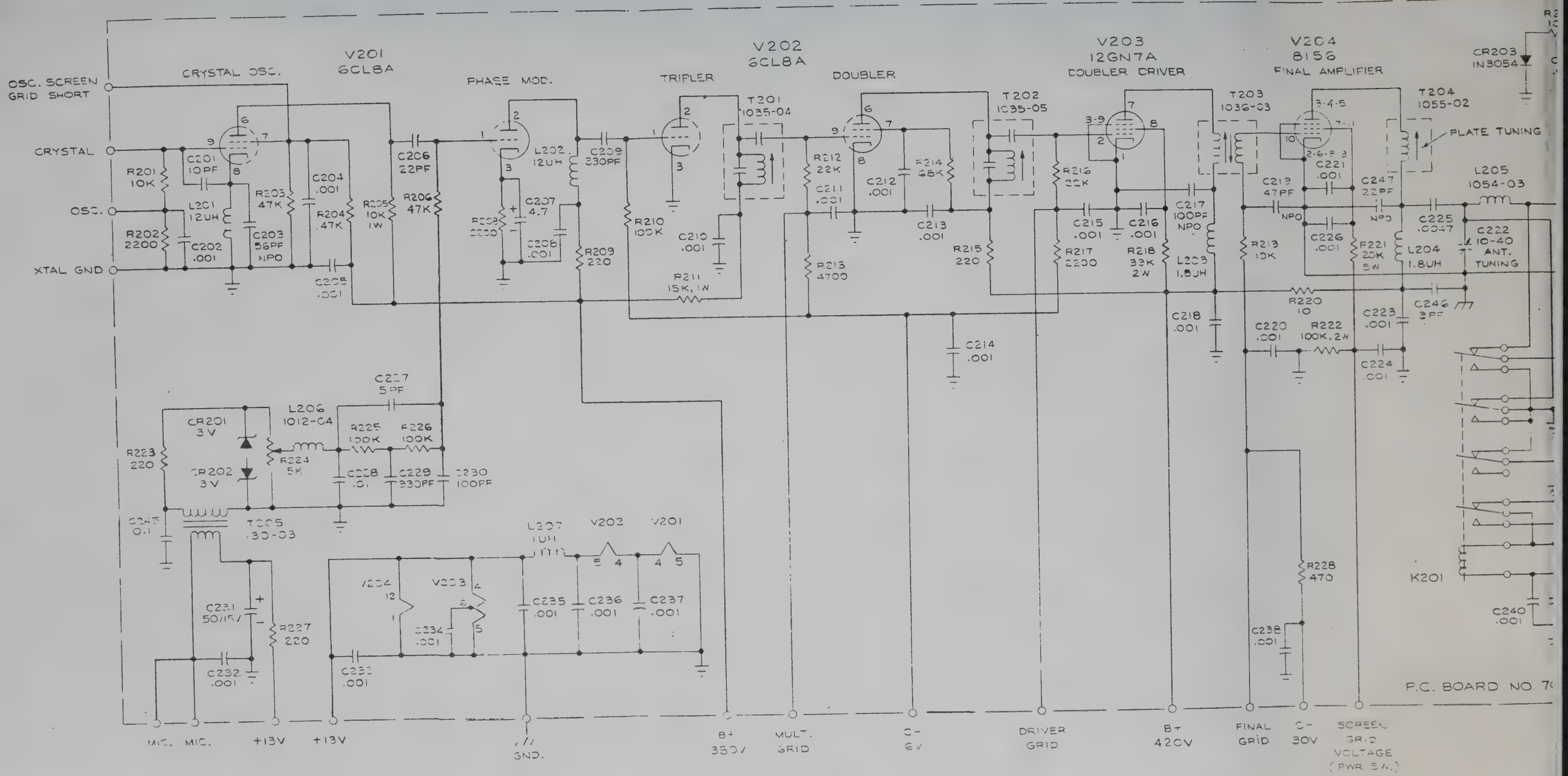
VOLTAGE MEASUREMENTS - CONTROL SETTINGS: POWER SWITCH "ON".
TRANSMITTER POWER SWITCH IN 25 WATT POSITION.
VOLTMETER: DC VOLTS - 20,000 OHMS PER VOLT.
AC VOLTS - 5,000 OHMS PER VOLT.
* USE VTVM FOR THESE READINGS.

TUBE AND FUNCTION		SOCKET PIN NUMBERS											
		1	2	3	4	5	6	7	8	9	10	11	12
6CL8A OSC. & MOD.	E	0	380	12	6.8	0	300	125	0	-6.5*	X	X	X
	R	250K	28K	2.2K	1.5	0	33K	0	2.5	12K	X	X	X
6CL8A MULT. X3-X2	E	-23*	250	0	6.8	13.6	420	190	0	-17*	X	X	X
	R	100K	38K	0	1.5	1.75	24K	90K	0	28K	X	X	X
12GN7A DRIVER X2	E	0	-21*	0	13.6	0	7	420	140	0	X	X	X
	R	0	25K	0	1.75	0	2.2	24K	57K	0	X	X	X
8156 FINAL AMP.	E	0	0	420	420	420	0	200	0	0	-60*	200	13.6
	R	0	0	24K	24K	24K	0	44K	0	0	11K	44K	1.75

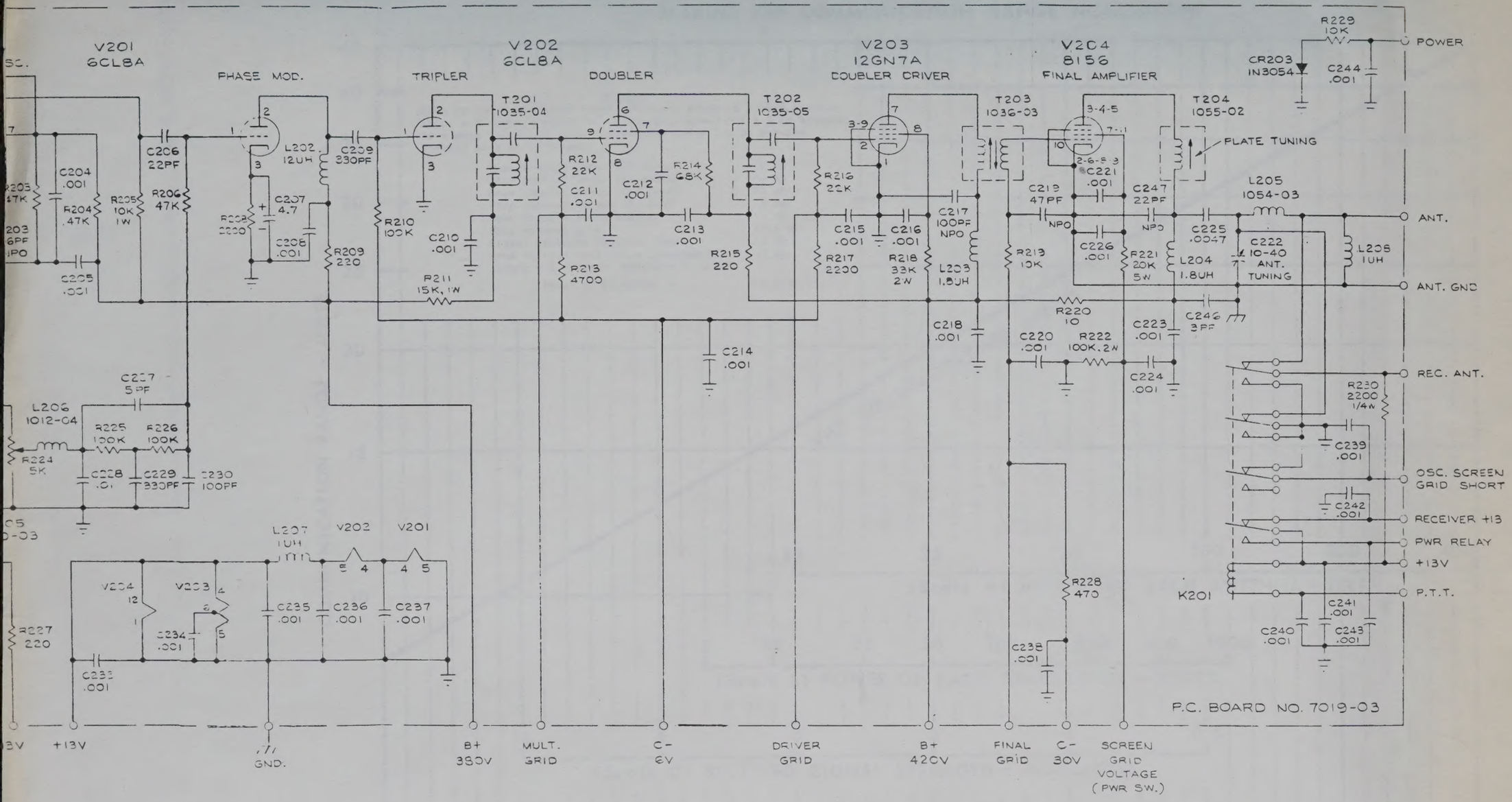
13.6 VOLT DC/DC CONVERTER POWER SUPPLY				
TRANSISTOR		BASE	COLLECTOR	EMITTER
BOTH 2N3772	E	20 VOLTS DC	0 (STUD)	12 VOLTS DC
	R	60	GROUND	10

TRANSMITTER VOLTAGE AND RESISTANCE CHART





NOTE:
UNLESS OTHERWISE SPECIFIED; ALL CAPACITORS ARE IN MICROFARADS AND RESISTORS ARE IN OHMS, 1/2 WATT.

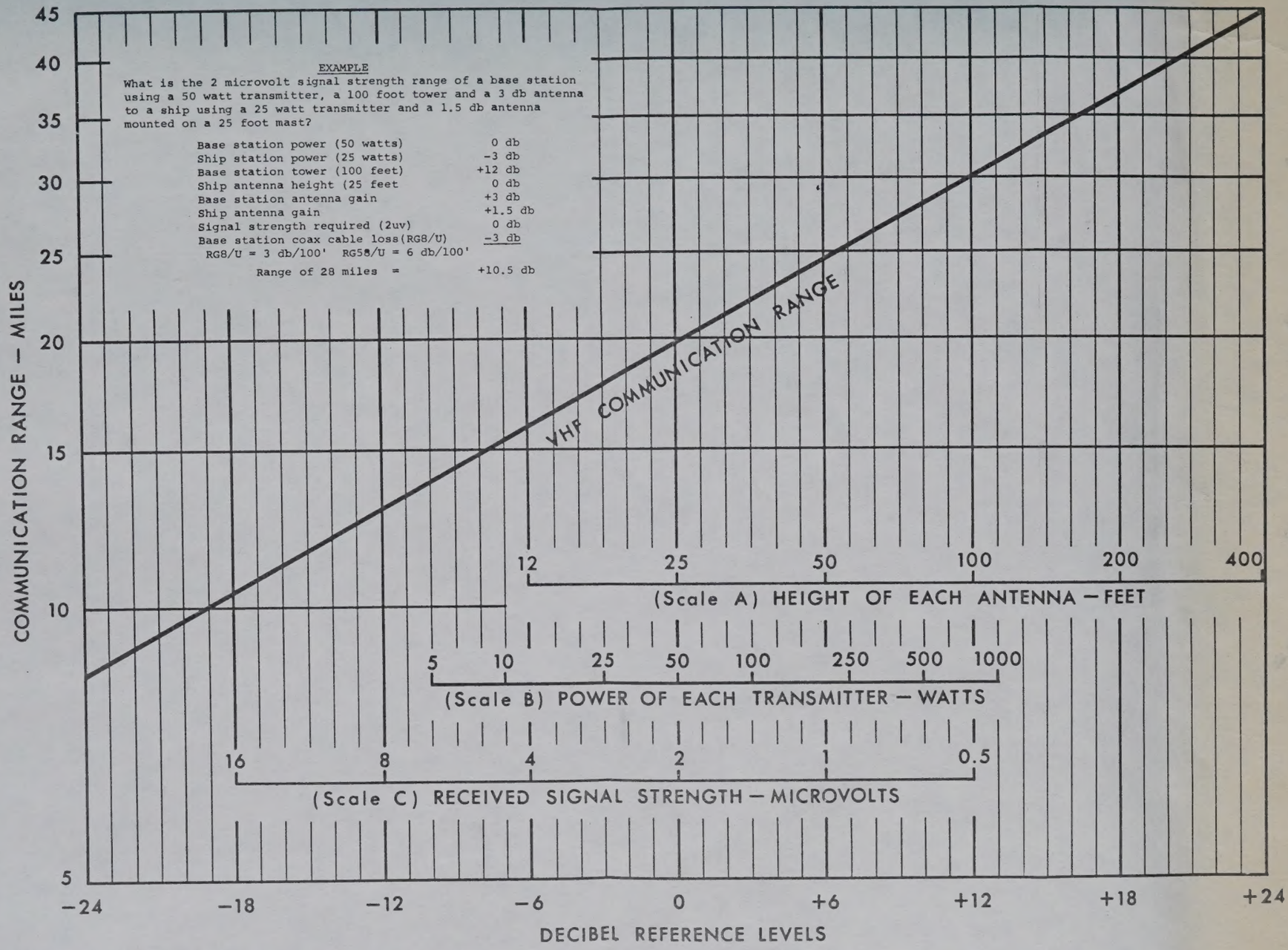


NOTE:
UNLESS OTHERWISE SPECIFIED; ALL CAPACITORS ARE IN MICROFARADS AND RESISTORS ARE IN OHMS, 1/2 WATT.

KONEL CORPORATION 271 HARBOR WAY SO SAN FRANCISCO, CALIF.	
TRANSMITTER SCHEMATIC	
KR-25VN	

KONEL CORPORATION

MARINE VHF COMMUNICATION RANGE NOMOGRAPH


EXAMPLE
What is the 2 microvolt signal strength range of a base station using a 50 watt transmitter, a 100 foot tower and a 3 db antenna to a ship using a 25 watt transmitter and a 1.5 db antenna mounted on a 25 foot mast?
Base station power (50 watts) 0 db
Ship station power (25 watts) -3 db
Base station tower (100 feet) +12 db
Ship antenna height (25 feet 0 db
Base station antenna gain +3 db
Ship antenna gain +1.5 db
Signal strength required (2uv) 0 db
Base station coax cable loss(RG8/U) -3 db
RG8/U = 3 db/100' RG58/U = 6 db/100'
Range of 28 miles = +10.5 db
COMMUNICATION RANGE — MILES
45
40
35
30
25
20
15
10
5
VHF COMMUNICATION RANGE
12 25 50 100 200 400
(Scale A) HEIGHT OF EACH ANTENNA — FEET
5 10 25 50 100 250 500 1000
(Scale B) POWER OF EACH TRANSMITTER — WATTS
16 8 4 2 1 0.5
(Scale C) RECEIVED SIGNAL STRENGTH — MICROVOLTS
-24 -18 -12 -6 0 +6 +12 +18 +24
DECIBEL REFERENCE LEVELS